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*Managing Editor*
NOLAN D. C. LEWIS, M.D.
New Jersey Neuro-Psychiatric Institute
Box 1000
Princeton, New Jersey

*Associate Managing Editor*
A. N. FOXE, M.D., *New York*
*Associate Editors*
PERCIVAL BAILEY, M.D., *Chicago*
KURT GOLDSTEIN, M.D., *New York*

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The Journal of Nervous and Mental Disease

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# DEVELOPMENT OF THE CONCEPT OF TIME IN CHILDREN[1]

DAVID E. SCHECTER, M.D., MARTIN SYMONDS, M.D., AND ISIDOR BERNSTEIN, M.D.

The psychiatrists involved in this study were engaged in a broader observational program of "normal" children at Ethical Culture School, Midtown Division, New York City, in which Dr. Isidor Bernstein participated as guide and supervisor. One of the conditions of the study was that there would be minimal interference with the school program, so that a more direct and controlled research study was not possible. As will be seen in the methods used, the material was gathered mostly from spontaneous remarks and from situations which were often structured but always part of the school program. The age groups included up to the time of this report were from the 3-year-olds of nursery school to the 6-year-olds of first grade elementary school.

Three factors should be stressed in reference to the group of children at this school. First, the great majority come from the more intellectual and sophisticated homes of the professional and upper middle class. Second, the children themselves are of an above-average intellectual group. Third, in any age group described there was quite a scattering of actual age so that, for example, in the 5-year-old kindergarten group there were a minority who had turned 6 at the time of these observations. All of these factors would tend to make for apparent and real precocity in the responses obtained.

## METHODS

Since completely direct and controlled techniques were not used, the cooperation of the teachers in eliciting the children's ideas was heavily relied upon. There were chiefly five methods employed:

1. Spontaneous remarks of the children.
2. Stories, which had direct or indirect relation to time concepts.
3. Pictures, e.g. of the seasons, of day and night, of old and young people.
4. The school's formal teaching program of time concepts and the children's remarks and responses to this.
5. Direct questioning of the children in relation to any one of the above methods.

## OBSERVATIONS[2]

The categories of time concepts form the structure around which the children's ideas were organized in this report. These concepts range from the primitive notion of "past-present-future" through the natural rhythms (diurnal and seasonal), to the conventional and more arbitrary time concepts, e.g. age, days of the week, months, the clock, etc. An attempt was made to follow chronologically the development of each of these concepts from the 3-year-old group to the 6-year-olds and to analyze some of the factors involved in the maturation and learning of them.

[1]This study was part of a program of training in Child Psychiatry at N.Y.U.-Bellevue Medical Center under the direction of S. Bernard Wortis, M.D.

This paper was presented at the Staff Conference, Bellevue Psychiatric Hospital, New York City on April 1, 1954.

[2] We are indebted to Drs. Soll Berl and Benjamin S. Gershwin who took part in this project, for permission to use their observations in the preparation of this paper and to the Ethical Culture School for their generous cooperation.

### 1. Past-Present-Future

These primary concepts were already well established in the 3-year-olds, so that we may safely say that they develop before this time. The 3-year-old has several time-words to describe the past, e.g. "before, yesterday, another day, last week." Although these words may imply different meanings of the idea of "past," the children used them in rather undifferentiated and general contexts. For example, one child said he saw the observer "yesterday" when he was actually referring to their meeting the week previously. Similarly, for the idea of future another child clearly confused "next week" and "tomorrow." The word "later" was understood as "not now" and was often used in the context of the postponement of pleasure, in which context it was probably learned. There was considerable difficulty in eliciting the nature of the 3-year-old's concepts because of his playfulness or distraction in responding, often purposely giving opposite answers and making jokes of these.

The older age groups have differentiated their past and future into more specific time concepts which will be discussed in the following sections.

In the Discussion part of this paper a hypothesis will be offered as to how the differentiation into a sense of past, present and future takes place in the infant. This whole area was excluded from observation because the younger age groups were not available, and would certainly be made difficult because of the scanty verbal communication possible before the age of 3.

### *2. Diurnal Rhythm*

The concept of "a day" as a formal unit of 24 hours did not appear until 5 years and then only a small minority were aware of this. In the "sixes," this idea appeared to be more firmly entrenched, though not universal. It should be mentioned that it was in the latter age group that a more intense teaching of the clock and time occurred.

The "threes" and "fours" characterized "day" in the following ways: "It's when the lights are on outside." "It begins when I wake up." Night was, "when the lights are out"; "when I go to sleep." Morning was, "when you have breakfast"; "when you wash yourself"; "when I have a b.m." Afternoon was, "mommy comes"; "when we have our nap." More than half of the fours could tell when it was morning and when afternoon.

The 5- and 6-year-olds for the most part characterized the above periods of the day in terms of the same personalized activities and experiences. There was, however, less emphasis on the physiological functions and more on play and interpersonal activities. Moreover, new external criteria were used, such as, "at night the planets shine"; "at night the sun goes down, it gets dark"—both quotations from 5-year-olds. These and other descriptions by "fives" show a greater grasp of the external world in its relation to the day and a higher level of abstraction. The threes and fours talked of "the lights" being "on or off" which appears to indicate a more concretized grasp of the rhythm of light and darkness in relation to day and night. The sixes emphasize their recently acquired knowledge of the clock and its hours in relation to the diurnal cycle.

The ideas of "yesterday, today, tomorrow," again revealed in the threes the lack of clear definition of these concepts as days. Some of the fours and most of the fives and sixes used "yesterday" and "tomorrow" in fairly accurate contexts, i.e. as the day preceding or the day to come. The fours and fives described the beginning and ending of each of these days mainly in terms of sleeping activities. The majority of sixes however, were beginning to define them in terms of days of the week, e.g. "yesterday was Tuesday."

Hence, we see in relation to diurnal rhythm a certain development in the characterization of the time concepts. In the younger age groups there is greater emphasis on the realm of immediate personal experience, at first on the physiological functions (bowel movement, sleeping, eating), and later on the interpersonal and play activities. With increasing age the realm of external factors becomes more important. In this realm there is a development from the more concrete of the 3-year-olds ("the lights are on"), to observations of rhythms of the universe of the fives ("the sun comes up"), and then to the even more abstract concept of the clock, especially in the sixes.

### *3. Seasonal Rhythm*

It was only in the 6-year-old group that a majority knew the names and sequence of the four seasons. The younger groups had very unclear ideas about spring and autumn. The threes described winter and summer mainly in terms of the weather and activities characteristic of them. Hence of winter they said, "it's cold;" "it snows"; of summer, "it's warm"; "we go to the beach"; "we go swimming." The fours recognized pictures only of winter and summer, relating these seasons mainly to weather, holidays and birthdays. A few of the fives, in addition to using the above criteria in their description, added the more abstract concepts of the longer day in summer and the relation of the seasons to the closeness of the sun. The sixes knew of spring and fall but were also vague about these two seasons. (This may very well relate in part to the indistinct seasonal nature of New York City.) Although the sixes described the seasons predominantly in terms of its activities, less than half knew the formal relation of seasons to months.

So, in the category of seasonal time we see the growth of the concept of time from the immediately personal, in terms of play activity and temperature sensations, to the more abstract ideas of relating season to length of day, to closeness to the sun, and to the months of the year. As a whole, however, the category of seasonal time was more poorly understood than was the diurnal.

### *4. Age*

The concept of age was somewhat easier to study because of frequent spontaneous conversation, especially in relation to comparison of ages. This was most evident in ages 4 to 6.

All groups knew their age in terms of years. Many of the threes knew their birthday month, and the fours, for the most part, knew the date of the month of their birthday, if not too much time had elapsed since their birthday. The fives and sixes took pride in knowing the exact date of their birth and expressed their age in fractions. Only a minority of these latter two groups, however, knew the actual year of their birth.

Although the children were accurate as to their own ages, they had a rather inaccurate concept of the age in years of people younger or older than themselves (except in the 6-year group). Their ideas of "old" were quite relative and broad, ranging from 9 through 17, 27, 60, and 300. However, most of the older three groups could quite correctly discern the relative youth or age from a series of pictures of people even though they had little idea of their actual age. The fives and sixes were quite astute in some of their observations of the aging process; "when you get old you stop growing"; "you get sick"; "you shrink"; "you get grey hair." The sixes knew the approximate age of their parents and most figured the life span of a person to be a hundred years or less.

Age depending upon the time of birth was a concept first found in the fives and sixes, although one 4-year-old said, "he is older because he was born before." For the threes and fours and even somewhat in the fives, age to a large extent was identified with size. The threes compared heights when one child had a birthday and revealed their belief that age was determined by size and vice versa. The fours, in playing with toy people made such remarks as, "the fireman is older because he is bigger and stronger"; "the oldest is the fattest." The fives began to compare their ages, however, by comparing their birth dates and determining who was older by who was born first. Furthermore, a younger but bigger child was able to explain, "I am bigger because I grew faster," which is a more advanced concept demonstrating the relation of size upon rate of growth and the differentiation of the concept of age from that of size. To state this in other terms, the time concept had become more abstracted and less reliant upon spatial, (i.e. size) models of time.

It was interesting to note that in the nonpersonal realm of plants and animals, none of the fours and only a minority of the fives could see age strictly as a function of time of birth or of planting, but they saw it still in terms of size. The sixes showed greater differentiation of the concepts of age and size and less confusion in this matter than did the fives.

Another concept which appeared to become established in the fives and consolidated in the sixes was that of conservation of age differences, projected either into the future or the past. For example, in the fives, only about

one-quarter, and in the sixes only one-sixth of the children believed that they might catch up to their parents' age in the future. The others realized that a child three years older than another will remain so in the future and has been so in the past. One 6-year-old said about a brother 1 year younger, "when I was 1-year-old he was not yet born." A 5-year-old stated that, "to ever be the same age as parents, you would have to be born the same time as they were, and then they would be too small to buy you from the hospital."

The two concepts, 1) of age being dependent on time of birth, and 2) of the conservation of age differences were found by Piaget[18] in his study to become established at the age of 7. Our results show the appearance of these concepts at the earlier ages of 5 and 6, but this discrepancy may partially be explained by the three factors characteristic of the group we studied which tend to make for apparent and real precocity.

### *5. Days of the Week*

Three factors were found in about the same proportions in the various age groups:

1. Knowledge of the current day of the week, e.g. "today is Wednesday."
2. Knowledge of the relationship of one day to another, e.g. "Tuesday is before Wednesday."
3. Ability to recite the days of the week in proper sequence.

These were the rough proportions in which these factors were found:

age 3 .....small minority (if any)
age 4 .....less than half
age 5 .....about one-half
age 6 .....majority

Knowledge of the week having 7 days first appeared in the fours and was present in the majority of fives.

All groups characterized each day in terms of personal or school activities in response to how they knew any particular day of the week. This is seen in table 1.

It should be noted that whereas the threes and fours for the most part characterize only Monday, Friday, Saturday and Sunday, the fives and sixes relate special school activities even to the middle days of the week.

From these observations, we may conclude that the days of the week have chiefly personal meanings to the children in all groups. Only in the fives and sixes is there a significant beginning of comprehension of the days of the week as an arbitrary cyclical scheme having formal relationships to each other which are not deepndent upon the realm of their personal experience.

### *6. Months and Year*

Many of the threes and fours and most of the fives and sixes knew their birthday month. Less than half of all groups (except the sixes) knew the current month at its inception. As

TABLE 1.—Characterization of Days of the Week

| *Days* | *Age 3* | *Age 4* | *Age 5* | *Age 6* |
|---|---|---|---|---|
| Monday | "start school" | "school starts"<br>"first day of week" | "week begins" | "school begins"<br>"rhythms" |
| Tuesday | no comment | no comment | "rhythms" | "music day"<br>"gym" |
| Wednesday | no comment | no comment | "middle of week" | "ice skating" |
| Thursday | no comment | no comment | "shop" | "music" |
| Friday | "no nap" | "no nap" | "ice skating" | "dates" |
| Saturday | "no school" | "no school" | "no school" | "no school" |
| Sunday | "play with daddy" | "visiting"<br>"TV" | "play with daddy" | "TV"<br>"visiting" |

the month progresses, however, most 5-year-olds will know what month it is.

It was only in 6-year-olds that a significant number of children knew the names of the months of the year and could recite them in proper sequence. In the fives and sixes there was some knowledge of months in relation to seasons and to holidays but this was neither widespread or always accurate. Only one exceptional 6-year-old child had such a grasp of the months of the year so as to be able to name the seventh month.

Similarly there was a rather poor concept of the year; only a minority of fives but most of the sixes knew what the current year was. The rudimentary and inaccurate nature of the concept of year and historical time is seen in a 5-year-old (soon to be 6), in the following conversation. "This coin is from 1944—that's old." ("Why?") "I just guessed it." ("What would be a new coin?") "1956" ("What year is it now?") "1953." Actual date was January, 1954.

Further observations on the children's concept of historical time and of the duration of various units of time were not made. Both these categories develop more fully in age groups older than we have studied here.

### 7. *Clocks and Telling Time*

The threes and fours showed little interest in the clock except in certain situations. Thus one boy would always ask what time it was when he was anxious about his mother arriving to take him home from school. Another would look at the clock and ask if it was time for lunch. In both groups no child could read the clock or offer alternate methods of telling time. They did know that "a clock is to tell time."

The fives began to show a lively interest in the clock and in ways of telling time. (It should be noted that at this age first attempts at teaching the clock are made.) They talked of the value of telling the time in terms of not being late for an appointment, for the rodeo, circus, a date, the doctor, the dentist, school, lunch. These indicate the range of their experiences which are influenced by more exact "clock time." When asked how one would know the time if there were no clocks in the world they offered the following suggestions for telling time: "Ask somebody else who has a watch." "When you get hungry you would know it's lunch time." "You would tell what time of day by the sun and sky." About one-half of the fives could read the clock in terms of the hour, only a minority in terms of the half-hour. Most were quite familiar with waking time and going-to-bed time.

The sixes were becoming very adept at telling time and showed a very lively interest in the subject. More than half could tell time up to 5-minute intervals, but only a minority to the 1-minute detail. The value of telling time for them was to a large extent to avoid being late for school and for various appointments. Although the latter were still largely pleasure-bent they were increasingly related to duty, routine and reality needs. Their suggestions for alternate methods of telling time were more elaborate and included the sun, the moon, the daily rhythm of light and dark, waterclocks, etc.

## Discussion

In the discussion we would like to briefly compare our findings with other studies in the literature and offer some speculations as to the nature of the development of the general concept of time and the specific concepts of past, present and future in the infant.

### 1. *Comparison of These Observations with Previous Studies*

In our survey of the literature in the English language on the subject thus far the only systematic study of the chronologic development of *each category of time* was that of Louise Bates Ames[1] with whom most of our age-level findings substantially agree. She also found a development from the specific to the general and from time related to activities to abstract time. Oakden and Sturt's[16] work was followed up by Bradley[5] who studied children over age 5. Although our children showed an earlier knowledge of most of the time concepts these authors studied, the general order of development is confirmed. Thus, concepts to do with personal references and natural cycles appear before the more arbitrary and conventional ones, e.g. the month, the calendar. Historical time and accurate estimation of time duration were found by them to develop between ages 9 and 13. We could certainly not agree with Bromberg[7] who generalizes that the concept of

past and future are needed only in the adult world, "and the child has need solely of a present." He quotes Stern[23] who is said to have found that the idea of a past does not appear until the fifth and eighth years. Ames[1] reports the use of words connoting past, present and future at the early age of 30 months.

### *II. Hypothesis of the Development of Early Time Concepts in the Infant*

As to the nature of the development of the concept of time, we have as yet arrived at no specific methods by which our speculations may be validated except by inferences and extrapolations suggested by the data we have gathered.

We have seen how in the younger age groups there is, in relation to time concepts, a greater emphasis on the realm of immediate personal experience—at first on the physiological, and later on the interpersonal and play activities. With increasing age, the realm of external factors becomes more important. There is a development from the concrete to the more general in observations of the universe as we go from the threes to the fives, and to the even more abstract concepts of clock and calendar, especially in the sixes. Notwithstanding the preponderance of the private personal factor in the time of the younger child, we have also seen the dependence of certain time concepts upon external factors, even in the youngest group studied here; e.g. the identification of age concept with size, and of "daytime" with "the lights" being on."

These observations suggest that the concept of time, as it develops, is neither a purely autistic, private function nor one which is completely an imposition on the child by the external world. The experience of time would appear to result from the interaction of these two spheres: 1) the child, with his more or less private experiences and rhythmic needs; 2) an "external world", with activities of the external physical forces, as well as those of the child's significant adults, both of these latter having rhythmic patterns of their own. The experience of time would seem to emerge from the rhythmic interaction, responsiveness and harmony of the two spheres. This would imply that with a chaotic or psychotic parent, or with disorganization of certain basic rhythms of the universe (e.g. seasonal, diurnal), the child would develop a very different concept of time than he does. Similarly, with disorganization in the other sphere, i.e. within the child, such as in early schizophrenia, a very disturbed concept of time would be expected and is found.

In effect, we have taken a "field theory" interactional view of the emergence of the concept of time. Now, there is a certain irrelevance to the philosophic question of whether time begins for the individual as a subjective private "lived time" ("temps vecue" of Henri Bergson), or as a more objective "physical time" ("temps physique"), dependent on events of the external world. It depends on both.

The more relevant question appears to be: At any given stage in the development of the concept of time, how much and what aspects of the private and the external spheres are operating? In tracing the development of each category of time, we have in part attempted to answer this.

Upon this thesis of the development of the general concept of time we will attempt to reconstruct how the primordial concepts of past, present and future may develop in the infant. These concepts involve the experience of the passage of time, of a sequence of events, so that events in the past, present or future become more or less reliable referential points in the child's total experience. We would conjecture that a feeling of passage of time may arise very early in infancy in relation to the tensions of physiologic and security needs and their satisfaction. The infant first experiencing the tensions of his needs, e.g. hunger, would probably be experiencing only in the time mode of the present. With repeated subsequent feeding and satisfaction, there evolves an experience of a sequence of events. In this sequence we have "hunger — feeding — satisfaction," and whereas each of these were originally experienced only in the isolated mode of the present, they become experienced in relation to the neighboring past or future state. Thus, the infant being fed may experience a change from his hungry state in the neighboring past to beginning satisfaction in the present. This experience of a sequence of events, which probably involves a primitive form of memory and learning from experience, would appear to be

the basis for the evolution of a sense of past, present and future, however autistic and concrete this sense of time may be at first.

According to Sullivan[24], "the alternation of need and satisfaction gives rise to experience or . . . is experience," in what he calls the prototaxic mode. "The need . . . begins to be differentiated in terms of the direction toward its relief which amounts to increasingly clear foresight of relief by appropriate action" (e.g. by crying), and ". . . this foresight is the experience of the neighboring future." This is Sullivan's attempt to explain the development of a concept of the future and the foresight function.

The infant's awareness of this kind of past, present and future must surely be in a mode of thought and experience quite alien to that of the adult. So that the question as to when and how the infant develops our adult, abstracted system of time is another matter entirely, and one whose development we have partly seen in the age groups of this study where their verbal capacities has provided us with a fairly reliable and lucid mode of communication. Our task in validating our speculations would be to find new methods of observing the behavior of and receiving communications from the infant in relation to his development of the concept of time.

Although we have no direct evidence of the above nature, there is some support for these speculations from other sources. Bergler and Roheim[3] see the perception of time as a function of the reality principle which always has a modicum of frustration. They give evidence from the productions of a hebephrenic, from fairy-tales and anthropologic data to show the relation of oral frustration and separation anxiety to the sense of the passage of time. They as well as Marie Bonaparte[4] point out on the other hand how the time concept is disturbed or becomes "eternalized" in various expressions of the pleasure principle of infantile omnipotence and of the unconscious, e.g. in dreams, fairy-tales, intoxication with drugs, mystical ecstasy, and in the schizophrenic and psychopath. The relation of time to reality and purpose was further elucidated by Oberndorf[17].

Lauretta Bender[2] points out that the rhythm of hunger tensions and oral satisfaction by itself would not be sufficient to account for the origin of the time sense. She noted that children deprived of maternal care and love in infancy develop a very poor sense of time (as well as psychopathic features), even though their oral needs were apparently cared for adequately. Thus, it would seem that an adequate maternal-infant relationship is of utmost importance to the development of a time sense. The "satisfaction" (referred to in our thesis of the rhythm of "hunger-feeding-satisfaction" as the basis of the time sense) must then involve not only the offering of milk or food but other indispensable interpersonal features such as warmth, contact and love. It would be difficult but invaluable to understand the connection of these interpersonal factors with the development of the sense of time.

### *III. Anthropological, Philosophical and Psychopathological Ramifications of the Time Concept*

Our interest in the general nature of time led us to consider briefly its many ramifications in the fields of anthropology, philosophy and psychopathology.

It has been shown that primitive people utilized two types of phenomena as their basis of time reckoning (14). First, there were the phenomena of the heavens, i.e. sun, moon and stars; and second, there were the phases of nature, i.e. the elements, plant and animal life. The generally accepted unit of time was the day. Daytime and nighttime were, at first, regarded separately. A day of 24 hours is a later concept.

A day was described by the American Indians by the concrete phenomena, the "suns." Some tribes had the idea that the sun originated afresh every day (15). The Polynesians reckoned time in "nights." The equivalent expression for yesterday was, "the night that is past." Other cultures used "moons," "darks," "sleeps" for their method of reckoning time. The idea of night as a unit of time is still carried in the language. The word fortnight is a contraction of 14 nights.

In dividing the day into parts, many cultures used the position of the sun. The American Indians had an expression for evening, equivalent to "sun sitting down." In Africa, an expression for noon was, "the sun over the crown of the head." One of the interesting groups

of expressions used by primitive people are those used in Madagascar. The expression for 2:00 A.M. was, "frog croaking"; that for 4:00 A.M. was "morning also night"; 6:00 P.M. was "sun dead"; 9:00 P.M., "people go to sleep"; 9:30 P.M., "everyone in bed"; 10:00 P.M., "gun fire."

As in young children, we have seen that some primitive people used concrete external events in their time reckoning. The personal or subjective elements were also used, but infrequently. Abstraction appeared minimally in the cultures described.

We would now like to consider the nature of time from the points of view of the philosopher and the physicist. In 1890, Henry James defined time sense as (13) "the awareness of a sequence of events." Le Comte du Nouy expanded this definition (10). "Time is the perception of sequence in the accumulated sense impressions. It is the relation between past perceptions and present perceptions. In its essence it implies memory and thought, or in other words, "consciousness."

Physical time is 1) uniform, 2) unlimited in extension, 3) unlimited in divisibility, and 4) its advance is irreversable (11). These attributes are modified by human adaptation. Time differs in uniformity of meaning to the individual. Its extensions are meaningful in terms of the life history of the individual. Its divisibility below 1/18 of a second cannot be discerned as to distinct tactile, auditory or visual stimuli (6). Its direction is from birth to death of the individual. It is again modified in varying psychiatric illnesses which will be discussed later.

In the estimation of time, another interesting concept comes up. Most people use spatial imagery or counting in the estimation of time duration. It has been shown that in the estimation of time above 5-second intervals one has to use aids, either spatial imagery or counting (9). This observation is in accordance with the physical concept that space and time are difficult to separate. H. G. Wells in his *Time Machine* states, "There is no difference between time and any of the other three dimensions of space except that our consciousness moves along with it." Hogben comments on the continuity of space and time (12). "From the standpoint of contemporary biology, the concepts of space and time owe their peculiar permanence to the circumstance that we cannot get away from our own labyrinthine organs or rhythms of our bodies."

The problem of whether time sense can be localized in the brain is unsolved. Studies have been done which indicate that the parietal lobe and adjacent parts of the temporal lobe which are connected to the vestibular apparatus are important stations for the perception of the sequences of the experience of time. Lesions of the occipital lobe will interfere in visual terms with time and space relationships. Lesions of the temporal lobe will interfere with time and motion and also with time and position-in-space relationships (19). Wechsler pointed out (25) that, "in lesions of the frontal lobe . . . there is no disturbance of time concepts." We do know, however, that patients with frontal lobotomy suffer a disturbance in planning and purpose. To date, due to the complexity of the time sense there has been no precise cerebral localization of it.

In various disturbances, "déjà-vu" states, depersonalization, obsessional neuroses, depression and schizophrenia, time sense is altered. In the déjà-vu states, the world seems far away and time does not seem to move. In depersonalization, the patient feels far distant from his previous life and experiences the present as if it were the remote past. In obsessional neurosis, time is often experienced as an eternity of tortures (20). With people who are depressed, the general complaint is that time no longer moves (21). In schizophrenia, the patient loses the inner relation to time experience. There is a regression from time perceptions of the outer world to those dependent on his own inner experiences. "... A schizophrenic patient looked at the clock, then looked at it at what he thought was an hour later but found it to be the same time. It was discovered that during this interval he fantasied doing what would ordinarily have taken him an hour" (22).

In order to understand these clinical observations in time disturbance there have been many interesting experiments. Schilder observed that in intoxications from mescal and hashish the passage of time may be extremely slowed and space greatly reduced. Du Nouy in a study of the influence of body temperature and

appreciation of time duration showed a positive correlation with the increase in temperature and shortening in the appreciation of time. This was in conformity with the application of the Vant Hoff acceleration coefficient in chemical reactions.

Other experiments reveal a biological clock in organisms (8). The fiddler crab is a dark color in the morning. By evening it pales. At daybreak it begins to grow dark again. Irrespective of temperature (from 6° to 26° C.), in a darkened room the color cycle continued. To account for this remarkable phenomenon it has been suggested that there is some kind of physical force in the environment affecting living organisms, some of which, like the fiddler crab, have a sort of internal clock responding to the external physical forces.

### *IV. Clinical and Educational Implications*

The implications and ramifications of an understanding of the development of the time concept are manifold. There is the practical educational aspect of what a child of a given year is capable of knowing. This has clinical as well as teaching significance. As we see so often, there are struggles between parents, especially obsessive ones, and their children relating to the subject of time. If we are aware of the norm for any given age, we may be able to separate normal functioning from rebellious dawdling or from the time difficulties of the schizophrenic or psychopathic child.

The understanding of the development of the time sense may shed light on the nature of the general maturational and psychological development of the child. We have pointed out the development from the concrete to the abstract, the physiologic to the interpersonal, the private autistic to the social, consensually-validated.

## Summary

1. Observations of the development of various time concepts in school children from ages 3 to 6 are presented.

2. It was found that in the younger age groups there is a greater emphasis on the realm of immediate personal experience, at first on the physiological and later on the interpersonal and play activities. With increasing age, the realm of external factors becomes more important. There is a development from the concrete to the abstract in observations of the universe as we go from the threes to the fives, and to the even more abstract concepts of clock and calendar, especially in the sixes.

3. An hypothesis is put forward as to the origin of the concepts of past, present and future in the infant.

4. Our observations and hypothesis clearly fall into line with a general theory of the development of self or ego from the autistic, private, pleasure-dominated world of the infant, where the boundaries of the self and the external world are obscure, to the more interpersonal, consensually-validatable and the more "realistic" social world of the older child where there is frustration of needs, and a development of routine and purpose, (with a trend in our culture to obsessive-compulsive behavior).

5. Ramifications of the time concept into the areas of anthropology, philosophy and psychopathology are briefly reviewed.

6. Some clinical and educational implications of this study are discussed.

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360 Central Park West
New York 25, N. Y.

# INDUCTION OF SLEEP BY AUTONOMIC DRUGS[1]

A. SZATMARI, M.D.,[2] AND R. A. SCHNEIDER[3]

## INTRODUCTION

The ultimate cause of the rhythmic alternation in our level of consciousness, the regular cyclic rhythms between sleep and wakefulness, is not fully understood—"there is no explicit explanation why do we spend one-third of our life in repose" (50). Sleep can be regarded as an active principle of tropho-tropism (24), and is a goal directed reversible physiological change in the autonomic integration towards the parasympathetic side. The integration of the autonomic innervation serves to maintain the proper external-internal milieu (6) for the best performance of the living organism. Normally, during the day, sympathetic activity is higher, but during sleep there is an increase of parasympathetic activity. The importance of increased parasympathetic tone in inducing sleep can be illustrated by the simple Balinese trick by which sleep can be induced by applying manual pressure on the carotid sinus (45). Furthermore, during sleep the following phenomena are found: 1) an increase of gastric secretion which is abolished by vagotomy; 2) bradycardia (30); 3) high levels of eosinophils and lymphocytes which decrease after awakening; diurnal rhythm (22); 4) the electrical resistance of the skin is increased (42); 5) the body temperature is decreased; 6) the lactic acid levels of the blood are lowered; 7) acetylcholine levels of cerebral tissue are elevated (43). The close connection of parasympathetic activity with sleep and recent reports that ganglioplegic drugs are useful for hibernotherapy (8, 9) drew attention to the possibility of inducing sleep without barbiturates. This was recently reported by Hoffer in an article entitled "Induction of Sleep by Autonomic Drugs."

[1] Saskatchewan Committee on Schizophrenia Research, supported by the Department of National Health and Welfare, Canada.

[2] Research Neuropsychiatrist, Psychiatric Services Branch, Department of Public Health, Regina, Saskatchewan.

[3] EEG Technician, Regina General Hospital, Regina, Saskatchewan.

As the EEG gives a fairly accurate picture of the level of consciousness (3, 7, 23, 35) it was decided that the investigation, to be described, would be conducted under EEG control.

## MATERIAL AND METHOD

The experiment was always carried out at the same time, 2:30 p.m., and the patient knew nothing about the experiment. The following day the patient was asked about his or her subjective experiences during and after the test. Three mg. of atropine sulphate were given intramuscularly followed by 1 to 1½ mg. of prostigmine intramuscularly 15 minutes later and by 200 mg of acetylcholine intravenously 15 minutes after that. Atropine sulphate as well as prostigmine block acetylcholine esterase. These three drugs cause a marked increase in the parasympathetic nicotinic activity while blocking muscarinic activity.

The EEG examinations were carried out on a Grass Model 111 B Console six-channel apparatus. For the parallel EKG examinations the standard two-lead RA-LL was used. This was recorded on the Grass instrument by using the EKG filter setting and by increasing the signal amplitude to the desired standard of 1 cm. deflection which equals 1 MV.

We have found in our investigations ("Homeostasis in Schizophrenia and Epilepsy," in press) that homeostatic activity in schizophrenics and epileptics shows both a quantitative and qualitative difference, and therefore our experiments were carried out on schizophrenics and epileptics and on normal volunteers. In all of our patients a series of homeostatic tests were carried out and will be reported elsewhere.

## EPILEPTIC GROUP

Our epileptic group consisted of seven patients from the ages of 16 to 35. The average age was below 25 years. Clinically, four had focal-cortical seizures, one was a photo-sensitive myoclonic epileptic, one had generalized seiz-

ures and cortical dysrhythmia, and one had periodic clouding of consciousness without convulsions. Brief case histories are given below.

*O. K.* This 16-year-old male patient had grand mal seizures preceded by temporal automatism and characterized by chewing movements of the mouth and clasping of the hands, followed by leftward rotation of his body. Neurological and air studies were negative. In the resting EEG there was marked cerebral dysrhythmia with a right anterior temporal delta focus accompanied by high voltage sharp waves. During the sleep study, some rightsided spiking was seen after the atropine, which increased after prostigmine (fig. 1a). Acetylcholine produced flattening in 5 minutes with random bursts of highvoltage slow waves bifrontally. In 20 minutes a long run of flat lowvoltage activity was seen, interrupted by high-voltage bifrontal sharp wave activity (fig. 1b).

*R. N.* This 29-year-old male patient had a cerebral accident at the age of 10, which was followed 5 years later by grand mal seizures preceded by aura. His resting EEG was normal and could not be activated by hyperventilation, but with metrazol a left anterior temporal focus was detected. In the sleep study his EEG was characterized by flat activity with some medium voltage slow waves, 20 minutes after administration of acetylcholine.

*A. B.* This 27-year-old female patient had had grand mal seizures for the past 10 years, each preceded by auditory vestibular aura. Occasionally the seizure followed forced thinking (*Penfield*). Her resting EEG was normal. With hyperventilation and photic stimulation a circumscribed delta focus was activated in the left anterior temporal lobe. In her sleep study atropine and prostigmine were ineffective in changing the pattern. About 5 minutes after acetylcholine a relaxed pattern was observed with regular 10/second alpha activity. Later a few bursts of slow sharp activity appeared in all leads. Twenty minutes after the drug general flattening appeared, interrupted by highvoltage sharp waves of symmetrical and synchronous appearance.

*N. W.* This 24-year-old female patient had epileptic grand mal seizures as a child which disappeared without medication. In April of 1953 she

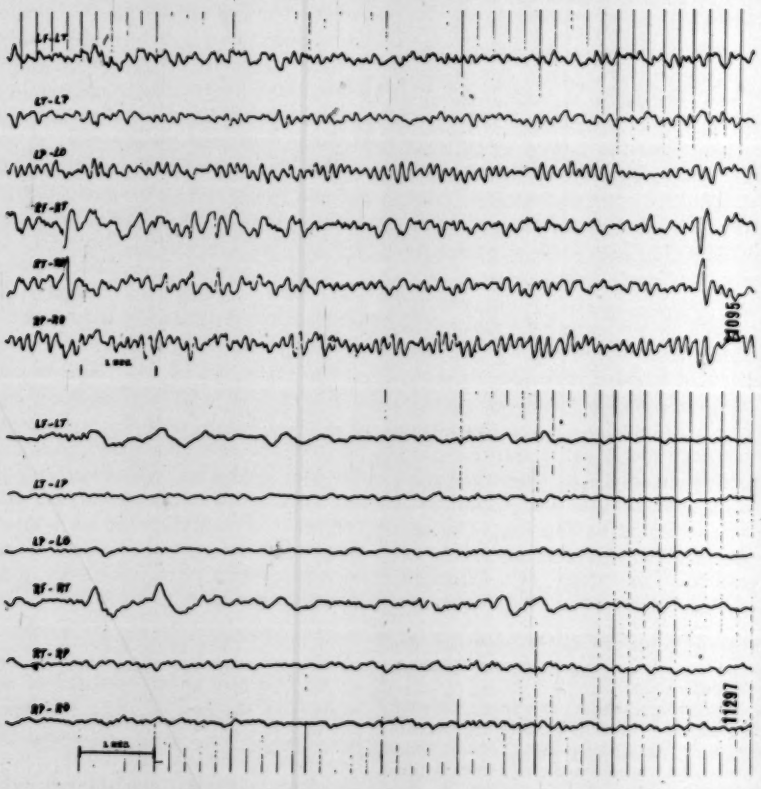

FIG. 1. (a) EEG in Subject O. K. after atropine and prostigmine. (b) After acetylcholine.

had two more grand mal seizures which were stopped with medication. Since then she has had numerous minor spells, as many as 60 a day. They are characterized by a sudden feeling of uneasiness and goose pimples over her entire body, which at times start on the left side. Her resting EEG was normal but hyperventilation readily produced 3/second high-voltage activity starting in the right temporal lobe. In her sleep study atropine and prostigmine produced some tension which was very quickly abolished by acetylcholine. Five minutes after receiving this drug there was a 10/second regular alpha activity over the entire cortex; occasionally typically sinusoidal. Fifteen minutes after the acetylcholine, bifrontal spindling appeared in the 15/second range, later followed by a general flattening and mediumvoltage 5–6/second activity (fig. 2a). In 25 minutes her EEG was characterized by bifrontal spindling, low-voltage 5/second activity and biparietal humps (fig. 2b).

*E. G.* This 17-year-old boy has had mixed grand mal and petit mal seizures for the past 5 years without aura. His resting EEG showed a very poorly organized rhythmicity with little hypersynchronicity, which increased on hyperventilation. Photic stimulation with 8/second flashes produced an immediate photo convulsive response and whenever the light was kept on he developed a seizure. The sleep study showed a very fast response to acetylcholine. In about 10 minutes general flattening appeared, followed by a burst of bifrontal spike and wave activity and mixed with highvoltage slow activity. Later a long run of flat recording was present, interrupted at times by highvoltage bifrontal spike and wave activity. Arousal studies restored the symmetrical pre-examination pattern, but after each arousal he would doze off again.

*J. D.* This 32-year-old man has had grand mal seizures only while sleeping for the past 10 years. His resting EEG showed no abnormality but hyperventilation and photic stimulation readily produced hypersynchronicity. In the sleep study atropine and prostigmine did not change the pattern. Five minutes after the acetylcholine, intermittent flattening appeared with bifrontal low voltage 15/second activity. In about 25 minutes the EEG was characterized by marked flattening, medium voltage 4/second activity, biparietal humps and then sudden bursts of highvoltage 2/second activity bifrontally.

*C. C.* This 35-year-old female patient showed periodic behavior disorder characterized by sudden rage and amnesia. Her resting EEG was normal and hyperventilation produced no change in the pattern.

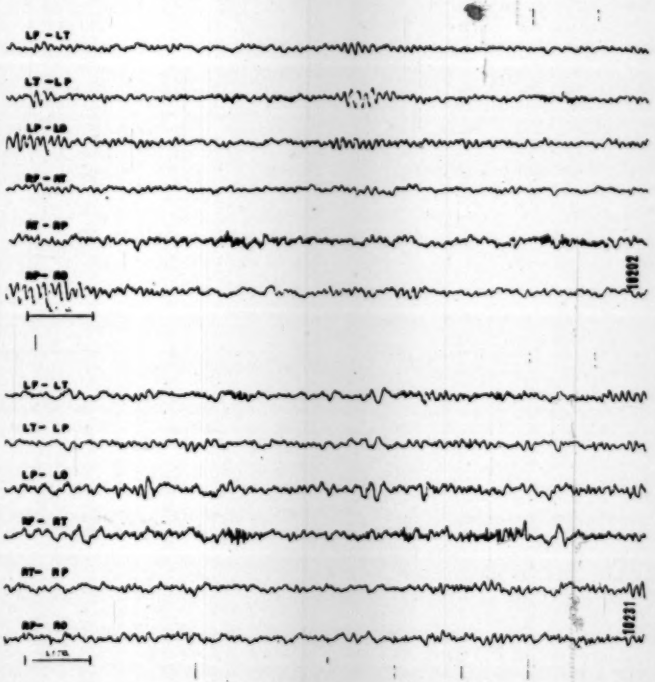

FIG. 2. Subject N. W. (a) EEG 15 min. after atropine, prostigmine and acetylcholine. (b) 25 min. after acetylcholine.

On photic stimulation in the 15/second range a marked response was obtained in the second subharmonic. On photo-metrazol activation, with a dosage of 2 mg. metrazol per kg. of body weight, bursts of irregular high voltage symmetrical slow activity appeared accompanied by confusion. Her sleep record was characterized by flattening, low voltage 5/second activity and biparietal humps. Every arousal was connected by typical K complex.

## Schizophrenic Group

*A. B.* This 22-year-old female patient showed primary ideas of reference, paranoid delusions, misinterpretations and changes in body image for the past 4 years. Her condition improved after 15 ECT's. The sleep study was carried out after the patient was clinically improved. Her resting EEG showed no pathological features. On hyperventilation she showed a marked build-up with bilateral high-voltage slow sharp waves, first in the right temporal leads. In the sleep study atropine and prostigmine produced no change in the electrical activity. Soon after acetylcholine general flattening was noted, lasting 20 to 30 seconds with spontaneous arousal. In about 15 minutes there was a general flattening of the entire record with bursts of symmetrical slow activity in all leads (fig. 3). Subjectively she reported that she felt dizzy and had many day-dreams, but she was unable to recall them. She had the feeling that the room "closed in," and she had no proper appreciation of time. There was an increase of feelings of unreality and she felt that everything was far away.

*R. E. S.* This 23-year-old male showed the typical picture of simple schizophrenia characterized by marked shallowness of affect, an increased tendency to day-dream, ideas of reference and feelings of unreality. He has shown these symptoms for the past 2 years. At 9 months he had 3 convulsions but since then has had none, and there is no family history of epilepsy. He had received no treatment before this investigation. His resting EEG showed a low-voltage, rather fast activity. On hyperventilation a left temporal focus was seen. In the sleep study atropine and prostigmine did not cause any change in the pattern, but in about 15 minutes after acetylcholine general flatness appeared followed by high-voltage slow activity of symmetrical and synchronous appearance. With this sleep pattern heart rate decreased markedly.

*P. K.* This 28-year-old female patient showed the clinical picture of a mixed hebephrenic-paranoid schizophrenic characterized by bizarre delusions of grandeur, auditory hallucinations mainly of a sexual nature, thought disorder and a marked change in her abstract thinking for the past 4 years with no treatment. Her resting EEG showed mixed 7/second medium voltage and low voltage fast activity. On hyperventilation, bursts of high-voltage irregular slow activity of synchronous appearance and symmetrical appearance was evident. In the sleep study during the atropine period she showed some "choppy activity" and prostigmine was ineffective in changing the pattern. Acetylcholine produced a very fast drop in the heart rate with some slow activity anteriorly. Twenty-five minutes after this bifrontal spindling appeared with a general flattening (fig. 4a). Thirty minutes after the acetylcholine biparietal humps appeared with medium voltage slow activity (fig. 4b). Later typical K complex was observed. The arousal studies produced a symmetrical answer with the return of the original pattern.

*K. B.* This 28-year-old female patient has had bizarre paranoid ideas, marked ideas of reference and changes in her body image for the past 5 years with no previous treatment. Her resting EEG was characterized by 8—10/second medium voltage activity posteriorly with low-voltage fast activity anteriorly. On hyperventilation bursts of irregular high-voltage symmetrical slow activity were seen. In the sleep study 10 minutes after acetylcholine

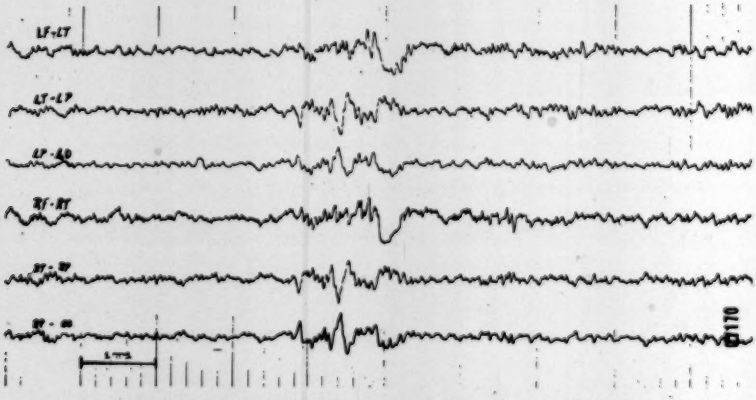

Fig. 3. Subject A. B. EEG 15 min. after receiving acetylcholine.

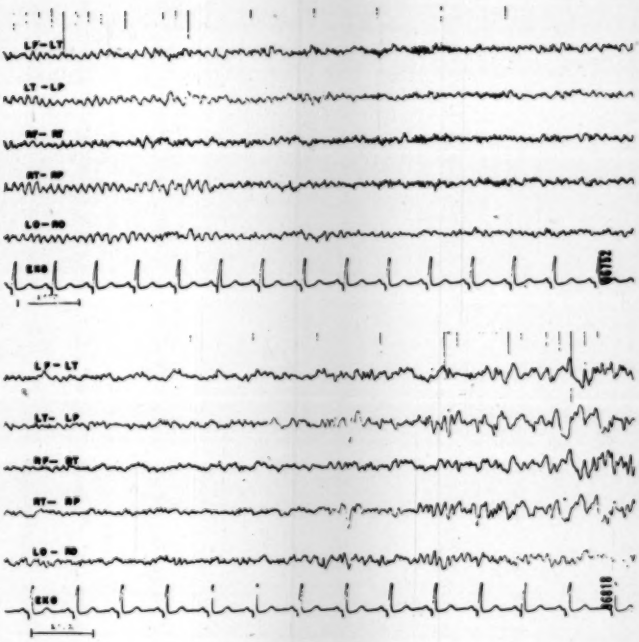

FIG. 4. Subject P. R. (a) EEG 25 min. after acetylcholine. (b) 30 min. after acetylcholine.

general flattening appeared with medium voltage 5/second activity in all leads.

*R. T.* This 35-year-old male patient slowly developed vague bodily complaints which mainly concerned his sex organs. He has had paranoid delusions for 2 years with no treatment. His resting EEG showed a well developed basic activity in the 10/second range mixed with low voltage fast activity. Hyperventilation was ineffective in changing the pattern. In the sleep study after the acetylcholine some general flattening of the record was observed without spindling or any slow activity.

*D. W.* This 38-year-old male patient showed signs of increased activity, withdrawal, shallow emotionality and loss of interest in his job and environment for the past 10 years. His EEG was characterized by low-voltage fast activity and hyperventilation produced no change. In the sleep study after acetylcholine some general flattening was seen without any other change.

## CONTROL GROUP

Our control group consisted of one normal volunteer whose subjective experience was described by Hoffer, one patient with disseminated sclerosis, and one with a left-sided post-concussional brain damage. In the normal control atropine and prostigmine had no effect on the electrical pattern. Acetylcholine produced intermittent low-voltage slow activity in the 5—6/second range in 20 minutes with very flat activity so that counting was not possible.

In the case of the chronic disseminated sclerosis the EEG was characterized by a symmetrical 5/second activity in all leads with bursts of bifrontal high-voltage 3/second activity. Atropine and prostigmine had no effect on the EEG and acetylcholine produced only a general flattening of the record.

The third case was a 53-year-old man who had had an accident 3 months previously, leading to a left-sided fracture of the skull and prolonged unconsciousness. In the EEG recording some marked left temporal delta activity was observed, but otherwise no pathological activity was present. In his sleep study, no change was evident during the 60 minutes of recording.

As this investigation was part of our homeostatic study the mecholyl test (19) was car-

TABLE 1.—COMPARISON OF EEG ACTIVITY, SLEEP ACTIVATION AND SYMPATHETIC ACTIVITY IN SCHIZOPHRENICS, EPILEPTICS AND CONTROLS.

| *Classification* | *No. of Cases* | *Paroxysmal EEG Disturbance* | *Sleep Activation* | *Sympathetic Hyperactivity* | *Sympathetic Hypoactivity* |
|---|---|---|---|---|---|
| Epileptics | 7 | Present in all cases | Positive in all cases | Positive in all cases | Absent in all cases |
| Schizophrenic Group A | 4 | Present in all cases | Positive in all cases | Positive in all cases | Negative |
| Schizophrenic Group B | 4 | Absent in all cases | Absent in all cases | Negative | Positive |
| Controls | 3 | Positive in one, negative in two | Moderate in one, negative in two | — | — |

ried out with all the patients. The epileptics all showed sympathetic hyperreactivity, the schizophrenics who showed paroxysmal activity in their EEG belonged to the same group and those schizophrenics whose EEG could not be activated (and who showed no sleep activity in our studies) belonged to the sympathtic hypo-reactive type. Thus those patients whose EEG showed paroxysmal activity showed a marked sleep response to our drugs whether they were epileptics or schizophrenics, and those patients whose EEG could not be activiated by hyper-ventilation or photic stimulation showed no or very little sleep response (table 1). Although our material is rather limited from which to draw any conclusions, some interesting theo-retical considerations follow.

In this report we were not entirely interested in the subjective experience of the individual tested, but rather we concentrated our interests on the electrical phenomena, because it is a well known fact that people are sometimes unaware that they have been asleep. In short, most of the patients whose EEG showed sleep activity reported drowsiness, sleepiness, and some of them had slight hesitant speech, stag-gering gait and nystagmus. Some of them re-ported "funny feelings," as "being far away," "feeling strange" or having "day-dreams." After the experiment most of them lay on their beds tired and drowsy, and a smaller amount of sedation than usual was required.

The slow and gradual change from the waking pattern to drowsiness and light and moderate sleep was very similar to natural sleep (7, 35). The first change was flattening of the record followed by sinusoidal 4—6/second activity, occasionally with 15/second medium voltage activity and random bursts of high voltage sharp waves and medium voltage 3—4/second activity.

The arousal responses (29, 36—38) showed the typical picture of arousal from normal sleep, characterized by K complex and reap-pearance of alpha activity. It is interesting to mention that in our arousal studies the patients did return to the same level which they had maintained before the arousal stimuli and in this regard their behavior was similar to that of people in normal sleep.

## DISCUSSION

In spite of the vast amount of literature concerning the neurophysiology of sleep, it is still not clear whether sleep is an active process produced by a sleep center located in the an-terior hypothalamus (20, 24), or whether sleep is only a negative phenomenon occurring in the absence of wakefulness. The investigations of Ingram & Knotte, Ranson, Magoun, Jasper, et al. seem to indicate that wakefulness is me-diated through a system called the "central ac-tivating system" which lies in the central core of the mid-brain and initiates and maintains the dynamic activity of the cortex. The damage of this system in the mid-brain in the posterior hypothalamus or in the inter-laminar system of the thalamus (15, 29, 36, 39) produces som-nolence, sleep or coma, and the activation of this system (29, 36) produces increased alert-ness, wakefulness and arouses the sleeping animal. During sleep there is a decrease of cortical "tonus" (4) but recent investigations indicate clearly (14, 29) that this deafferentia-tion of the cortex is due to decreased activity of the non-specific afferent system.

In a recent investigation it was demonstrated (12) that during barbiturate or ether anesthesia

the electrical activity of the specific afferent system is not decreased at first, but the electrical activity of the non-specific central afferent system showed marked delay and decreased intensity. According to Arduani and Arduani, Nembutal and Dormison selectively depress the medial part of the reticular formation leaving full responses at times within the lateral paths. Slight anoxemia acts in a similar fashion. Pathological findings and experimental investigations demonstrate that sleep is caused by a decreased activity of the above-mentioned central non-specific afferent system.

It is not quite clear however why normal sleep occurs at all, but as sleep-wakefulness and the most important homeostatic mechanisms are located in the very same place (5, 16, 17) it seems evident that sleep and the regulation of the internal milieu are now connected. Although it is difficult to make a clear-cut division between the localization of sympathetic and parasympathetic activity in the hypothalamus, it appears that the posterior hypothalamus is connected with sympathetic activity and the anterior hypothalamus is connected with parasympathetic activity; but recent investigations (33, 34) have demonstrated that these functions overlap as they were able to elicit sympathetic and parasympathetic activity from the same place depending on the quality of the electrical stimuli.

It is evident that in sleep there is decreased sympathetic reactivity and a rather increased parasympathetic activity, but we do not know which appears first. Whether the first step in sleep is a decrease in sympathetic reactivity (a decrease of the "fight and flight reaction" Cannon) or an increased parasympathetic activity initiated from the anterior hypothalamus is not clear. The recent interesting investigations and experiments in regard to artificial hibernation (2, 11, 32, 49) seem to throw light on this problem. The essence of this procedure is to put the autonomic nervous system at rest. The drugs which were used (chloropromazine and its derivatives) have partly adrenergic blocking effect and partly depress the nervous system on the diencephalic level. They also lower the body temperature (2) by decreasing the oxygen requirements of the tissue. Hoffer (personal communication) was also able to demonstrate that atropine lowers the body temperature in schizophrenics and some epileptics. The connection between the decreased function of the central nervous systems and hypothermia seems to be important because the speed of the neuronal activity depends on temperature. The lower the temperature, the slower the nervous activity (Hoff's law) and so in poikilothermic and extinct animals, the lowering of the external temperature at night causes a marked slowing down of their nervous reactivity.

For the struggle in life, it seems very important to maintain the nervous activity to prepare and allow for "fight and flight." From this point of view we may consider sleep as a rudimentary phylogenetic process, "in our brain, we inherit the need to retire from active strife as darkness falls, even though . . . we can maintain our body temperature within a fraction of a degree" (50). It seems possible that the depressant property of the ganglioplegic drugs are partly connected with decreased sympathetic reactivity.

According to Fischer 2 important factors are present in the mechanism of model phychosis: adrenergic stimulation corresponding to the shock phase of the general adaptation syndrome of Selye and a subsequent adrenergic blockage produced by the drug. In artificial hibernation, if there is only adrenergic blockage present without stress, it results in sleep. The question is, though, how does the atropine, prostigmine and acetylcholine combination act as a sleep activator? Atropine in high amounts intravenously may produce sleep-like conditions (18) by blocking the acetylcholine activity. In our experiments, atropine and prostigmine did not produce any sleep-like condition, sleep appeared only after acetylcholine was given. As atropine blocks the muscarine-like effect of acetylcholine but keeps the nicotine effect intact, and prostigmine blocks the acetylcholine esterase thus maintaining a fairly high amount of acetylcholine level, it would appear that in our experiments sleep is connected with a fairly high amount of acetylcholine. This is confirmed by the investigation of Dawson and Richter who found a 50 per cent increase of acetylcholine during sleep. We know that on giving acetylcholine and preventing its destruction by prostigmine, we are able to produce paralysis on accumulation of acetylcholine on

the synapses (37, 38). Pope was able to demonstrate that the acetylcholine esterase activity is highest in the cortical layers I–III in which region the non-specific afferent systems arborize. He suggests that the esterase is primarily associated with the synaptic terminals. As the "central activating system" is a multi-synaptic one, it seems possible that a slight imbalance in the delicate acetylcholine metabolism may cause decreased activity in the above mentioned systems, thus resulting in a partial cortical deafferentiation and causing sleep-like conditions.

There is a second way in which these drugs may initiate sleeplike conditions. It has been shown that proprioceptic stimuli are the most important factors in maintaining wakefulness (20,30). As atropine decreases the activity of the lower midbrain centers, which play an important role in maintaining muscle tone, the decrease of the "feed-back shower" may result in a sleep-like condition. The central depressant property of certain antihistaminics (parpanit), which are used to decrease the extrapyrimidal rigidity, have been similarly explained (48).

There is one more theoretical consideration, namely, the positive correlation between EEG lability (hypersynchronicity) and sympathetic hyperactivity tested with mecholyl (19), and the ease with which sleep can be produced with our drug combination. The important factor in this regard seems to be the EEG lability and not the clinical diagnosis of the patient. It appears therefore that the degree of stability depends on the functional organization in the mid-brain, and the degree of stability of the EEG can be utilized to measure the degree of integration of the diencephalic structures; this degree of integration expresses the adaptive capacity of the organism. High adaptive capacity means resistance, i.e. purposeful economical adaptation to stress. On the other hand, a low degree of adaptive capacity means a tendency to less purposeful and less economical adaptation. In this teleological concept the epileptic discharge appears as an adaptive homeostatic function (25, 44, 46) and it is somewhat similar to the adaptive quality of the sympathetic hyperreactivity within the diencephelon. The variance in the degree of neuronal stability denotes the difference between normal and pathological, i.e. epileptic and schizophrenic. As compared with the normal, average individual, the diencephalic organization of the epileptic may be described as a system which is characterized by an increased tendency to turn over (erhote Umkippungsgeschwindigkeit). In schizophrenia, the diencephalic organization of the homeostatic function is seemingly disturbed due to: (a), shift toward the vago-insulin discharge in stress (20), (b) a high level of physiological activity during rest thus showing less variability (51) and (c) vulnerability of the diencephalic organization (10).

In accordance with our concept of a homeostatic purpose of lability, the cases with a high degree of lability possess a more suitable homeostatic capacity, and such homeostatic capacity may correlate clinically with a better prognosis, and cases with minimal or no lability and of minimal adaptive capacity have poor clinical prognosis. The more labile the system, the less resistance it offers towards changes in mileu. This mechanism is exemplified by the ease with which our drug combination produced sleep in patients with EEG lability.

## Summary

1. Atropine, prostigmine and acetylcholine, administered as described by Hoffer, produce drowsiness, light and moderate sleep resembling natural sleep, as recorded in the EEG.

2. Patients whose EEG show paroxysmal abnormalities (epileptics and schizophrenics) are more susceptible to this procedure than patients (schizophrenics) who show no paroxysmal abnormality in their EEG.

3. Normal control groups respond with a mild reaction when compared with Group 1.

4. There seems to be a positive correlation between sympathetic hyperreactivity and sleep activation.

5. A tentative explanation is offered as to the mode of action of the above drug combination.

## Acknowledgments

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# CHLORPROMAZINE IN THE TREATMENT OF SCHIZOPHRENIA

## A Study of 75 Cases

ALBERT A. KURLAND, M.D.[1]

Chlorpromazine[2] was originally developed at 4560 R.P. by the Rhone-Poulenc Specia Laboratories in France and marketed by them under the trade name of Largactil. In their efforts to capitalize on the troublesome capacity which the antihistaminics have of making people drowsy, the Rhone-Poulenc Laboratories had investigated a series of amine derivatives of phenothiazine. These derivatives constitute a group of pharmacodynamic agents whose specific effects are antihistaminic or antiparkinsonian. Of these compounds, Chlorpromazine was found to be the most powerful "antihistamine sedative" (1). It engaged the attention of the French surgeon, Laborit (7), in his search for a compound that would enhance the action of general anesthetics.

The theoretical formulations which led Laborit to its application in an effort to bring about an "artificial hibernation" are of great interest. Laborit stated: "What we are accustomed to call our defenses, defend merely the constancy of biological conditions in our internal environment. This control is the result of our evolution. The 'defense mechanism', so far from defending our existence, are very frequently the more or less direct cause of death. The error arises from confusion between evolved traits and vital phenomena. The therapeutic consequence of this error has been that, hitherto, no means have been spared to assist these so-called defense mechanisms; whereas if the intensity and duration of the aggression do not transcend the reactive capacities of the organism in question, restoration of balance will come about of itself through the operation of the regulatory systems, in particular, the neuro-endocrine; and in the contrary case, strengthening of the alleged defenses can only accelerate parenchmatous and energic exhaustion, and precipitate death. Thus a reduction of the reactive amplitude of the organism seems to us to be indicated. This purpose can be accomplished with the aid of certain medicinal agents of comparatively recent discovery, all of which have the property of opposing the propagation or action of neural transmission by inhibiting the chemical agents liberated by its function. Such neuroplegia must act at all levels of the neurosympathetic reflex circuitcentripetal route, central relays, peripheral ganglia of centrifugal routes, and terminal effectors. Neuroplegia prevents diffusion throughout the organism of irritation due to an aggression, and at the same time moderates glandular functions. This is what we have called 'artificial hibernation'. Artificial hibernation is only superficially analogous to earlier experiments of Fay and Allen without neurosympathetic blockage, in which refrigeration is applied under anesthesia."

Laborit (8) also indicated that the investigations of hibernating animals have shown that such animals are extremely resistive to shock and easily survive injuries that would be fatal to them in their normal state. In his efforts to bring about a state of 'artificial hibernation' as a protection against shock and the often fatal general collapse that follows severe injury or illness, Laborit felt that more than just deep sleep was necessary. He wanted to lower body temperature, slow the heart, reduce the oxygen consumption of tissues—in short, put patients into a state of partially suspended animation. The antihistaminic sedatives, particularly Chlorpromazine hydrochloride, proved particularly promising in bringing about hibernation-like states, and were applied in surgical procedures to prevent shock and postoperative sickness.

In January 1954, Wortis (12), reviewing the status of Chlorpromazine, stated: "The compound is primarily a ganglioplegic. Its

[1] Director of Medical Research, Spring Grove State Hospital, Baltimore 28, Maryland.

[2] The Chlorpromazine used in this study was supplied by Smith, Kline and French Laboratories as Thorazine.

action is described as vagolytic, sympathiocolytic, antipyretic, and antiemetic. Its sedative action potentiates the effect of other hypnotics, narcotics, anesthesia, analgesics; it is mainly a vegetative inhibitor and to a lesser extent a sedative. It may be applied to the treatment of all conditions in which vegetative disturbances play a role, such as anxiety states, severe neuroses—including obsessions, symptoms following drug withdrawal, manic depressive disorders, certain cases of acute florid schizophrenia, and a wide variety of psychomotor disorders. Clinically, it induces a slowing of the pulse, a lowering of temperature, blood pressure and basal metabolic rate, a slowing of respiration, and a transient leukopenia. Chlorpromazine induces somnolence, lethargy, or actual sleep. The patients talk little, display little affect, and prefer to be left alone. There is a general psychomotor retardation. The sensorium, however, remains clear and all intellectual functions intact."

The introduction of Chlorpromazine into psychiatric therapy occurred in 1952, when a number of French publications appeared which were devoted to the Chlorpromazine treatment of certain forms of psychosis. In a first investigation, Hamon, Paraire and Velluz (6) reported the case of a young man with maniacal attacks who, at the time of a relapse, received Chlorpromazine combined with Pentothal for 19 days. An intravenous injection of Chlorpromazine produced each time a sedation lasting several hours; it was well tolerated and it facilitated adjustment to normal life. The same authors reported several cases of anxiety states treated by a Chlorpromazine-Phenobarbital combination, and they considered the intravenous route to be the most effective. They carried out a treatment which was neither a sleep treatment nor a hibernation treatment, and which reduced the attacks of anxiety to a remarkable extent. As a form of sleep treatment, Deschamps (3) used Chlorpromazine in combination with Phenergan, Diparcol, Phenobarbital, Soneryl, and Amytal according to a particularly complex formula. This author obtained good results in anxiety melancholia, in maniacal states with frequent outbreaks, and in hallucinatory deliriums with anxiety. Treatment resulted in a state of apathy towards the environment and a sedation of the agitation and the anxiety, as well as a return to almost normal, prolonged sleep.

It was chiefly the investigation of Delay and his co-workers, Deniker, Harl and Grasset (2) which showed how valuable Chlorpromazine was in psychiatry by first reporting a series of 38 psychotic reactions treated by this drug. These authors showed that Chlorpromazine was very effective in maniacal states but that cessation of the treatment could bring on a relapse. It seemed to them that there was selective action on the confusional syndrome associated with agitation. In their initial cases of depressive, anxiety or melancholic reactions, they obtained varying results. In schizophrenia, they reported only temporary and partial remissions.

A European literature rapidly accumulated as other confirming reports appeared telling of good results. In the United States the first published reports of the effectiveness of this drug were those of Lehmann and Hanrahan (9) and Winkelman, Jr. (11).

With these favorable reports as our guides, we began to treat a series of psychotic patients without respect to specific diagnostic categories. The patients were selected because they were difficult nursing problems, and the other treatments had reached a point of diminishing returns. The symptomatology displayed by these patients was manifested by one or several of the following factors—extremely noisy for prolonged periods of time, confusion of such a degree that they needed constant supervision, agitated, destructive, hyperactive, impulsively assaultive, denudative, smearing, soiling, requiring repeated seclusion and sedation.

## Method

No specific facilities were used to house the patients. They were treated on their own wards, and any sedatives being administered were withdrawn a few days prior to the onset of treatment with Chlorpromazine. The drug was administered by mouth in cooperative patients; otherwise it was given intramuscularly in doses of 50 mg., t.i.d. In elderly, debilitated patients the initial dosage was 25 mg. with bed rest. The most disturbed patients received the maximum dosage that we administered parenterally, 50 mg., q.i.d. As soon as they were capable of taking medication orally, the

patients were given a combined administration of oral and parenteral medication, averaging 350 to 400 mg. daily. This dosage level was not exceeded since it was decided arbitrarily to stop treatment in 4 to 5 weeks if the patient showed no response to the trial of treatment. Our decision was based on two factors: we were apprehensive about higher dosage because of the complications reported in the literature; and, as our experiences accumulated, we were anxious to separate our "reactors" to the medication from the "non-reactors" for further experimental investigation. In some of the cases, however, exceptions were made and the experimental design modified (see case 3, M.C., and Figure 1.

The methods for evaluating the effectiveness of the treatment were: 1) reports from the attending physician; 2) nursing notes and interviews; 3) daily observations; and 4) some of the patients were assessed on a behavior-rating scale by an observer. The clinical evaluation also took into awareness the experiences of Elkes and Elkes (10) with Chlorpromazine. These investigators pointed out that during the first two weeks of the trial treatment most of the patients seemed better. They became quieter and more responsive. This effect, however, was transient and relapse to the behavior usual for the patient was not long in forthcoming, except in those in whom a genuine response to the drug was observed. Such illusory improvement may be due to the unaccustomed daily attention which the patients were getting and their knowledge that they were undergoing a new type of treatment. The

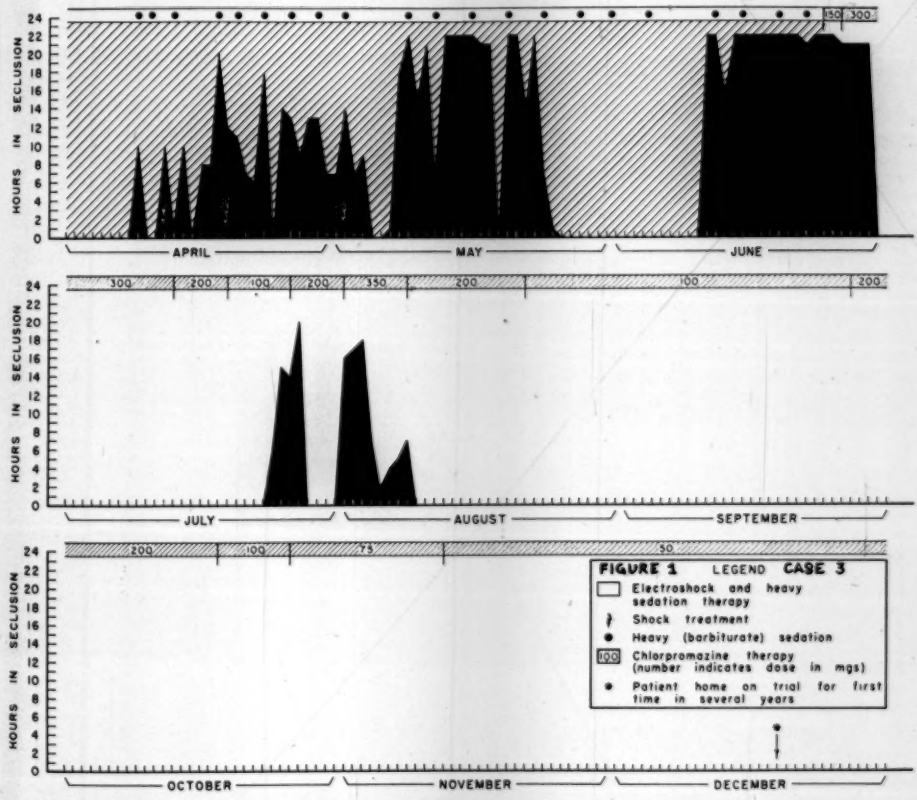


FIG. 1

Staff's enthusiasm soon found its own level, and as the weeks went by, the effects of the drug could be more clearly distinguished.

Accordingly, the criterion was adopted of evaluating the reactions to Chlorpromazine in the following categories: 1) marked improvement—there was a complete reversal of patient's attitude and behavior with an increasing participation in ward activities and interpersonal relations; 2) moderate improvement—the patient was less disturbed, more easily managed, and began to take some part in hospital activities; 3) minimal improvement—the patient seemed a little less disturbed than usual to the medical and nursing staff who were thoroughly familiar with the pattern of the patient's behavior; 4) improvement with transient episodes of regression; 5) transient episodes of improvement; 6) no change; 7) made worse.

## Observations

Table 1 indicates the results obtained during the time the 75 patients were under treatment.

Table 2 is a comparative study of our results and those reported by other investigators. The results of the Elkes (4) study are particularly important to us since their clinical

TABLE 1.—Response of 75 Psychotic Patients to Chlorpromazine (Thorazine) During the Period of Drug Administration Over a Period of 4 to 8 Weeks. Dosage Ranging From 50 mg. to 350 mg. Daily.

| *Response* | *No. of Cases* | *Percentage* |
|---|---|---|
| Markedly improved | 12 | 16.0 |
| Moderately improved | 13 | 17.4 |
| | | 33.4 |
| Minimal improvement | 14 | 18.7 |
| Transient episodes of improvement | 17 | 22.6 |
| | | 41.3 |
| No change | 17 | 22.6 |
| Made worse | 2 | 2.7 |
| | | 25.3 |

TABLE 2.—Comparison of Spring Grove State Hospital Results With Other Series Reported in the Treatment of Psychotic Patients With Chlorpromazine (Thorazine).

| *Investigators* | *No. of Cases* | *Improvement* | *Transient* | *No Change* | *Duration* | *Dosage* |
|---|---|---|---|---|---|---|
| | | *per cent* | *per cent* | *per cent* | *weeks* | *mg. daily* |
| Elkes and Elkes (10). | 23 | 25 | 42 | 33 | 6 | 75–300 |
| Lehmann and Hanrahan (8) | 24 | 18 | 50 | 32 | 16 | 50–800 |
| Douglas Goldman (11) | 226 | 15 | 40 | 45 | 8-12 | 75–200 |
| Moyer-Kinrose Wright-Finney (12) | 64 | 42 | 49 | 9 | 1-2 | 50–600 |
| N. Wm. Winkelman, Jr. (9) | 28 | 54 | 32 | 14 | 8-32 | 100–400 |
| S. G. S. H. | 75 | 33.4 | 41.3 | 25.3 | 4-8 | 50–350 |

TABLE 3.—DURATION OF ILLNESS RELATIVE TO IMPROVEMENT.

| *Duration of Illness** | *No. of Patients* | *Patients Showing Marked Improvement* | *Patients Showing Minimal Improvement* | *Total No. of Patients Showing Improvement* | *Percentage Showing Improvement* |
|---|---|---|---|---|---|
| 1 or less | 11 | 4 | 3 | 7 | 63.6 |
| 1-2 years | 11 | 2 | 0 | 2 | 18.2 |
| 3-5 | 16 | 1 | 3 | 4 | 25 |
| 5-10 | 17 | 1 | 1 | 2 | 11.8 |
| 10-15 | 6 | 1 | 2 | 3 | 50 |
| 15-20 | 6 | 2 | 3 | 5 | 83.3 |
| 20 or more | 8 | 1 | 1 | 2 | 25 |

* Arbitrarily set from time of first admission to a psychiatric hospital.

setting so closely parallels ours. In addition, their approach followed the rigid criteria for validating results by the administration of placebos over a period of several weeks alternating with the administration of Chlorpromazine.

Table 3 was an attempt to determine what relationship there was between duration of illness and improvement. It was Douglas Goldman's (5) impression that best results were obtained in patients with mental illness of less than 5 years' duration. It was his impression that 95 per cent of the failures seen in the treatment of schizophrenics and manics were in patients whose illness was of 5 to 20 years' duration. Our results based on a small sampling seem to tend in this direction.

Some illustrative cases indicating rather dramatic responses to therapy are outlined.

## CASE REPORTS

*H. V. D., Case 1.* This is the fifth illness of this type that the patient has had. In 1937 she was hyperactive and overtalkative, and was admitted to Phipps Clinic and after 3 months transferred to Sheppard Pratt. Several months later her husband took her home very much improved. She was well until 1941 when she again became agitated and upset and was admitted to this hospital. She was noisy, hyperactive, and combative. The diagnosis was schizophrenia with manic features. She showed good improvement and was put on probation in May of 1942. She continued well until March of 1947 at which time she became depressed and preoccupied with religion, and at her own request was admitted to the hospital in April of 1947. She had paranoid ideas and was deeply preoccupied with religion while in the hospital, but showed improvement with psychotherapy and was discharged in July. In April of 1950 the patient was again admitted to the hospital apparently after 1 week of disturbance, this being characterized by delusions of grandeur. She was excited and aggressive in the hospital. ECT was given to her and she responded well. In July she was placed on parole. Patient's last admission occurred in May of 1954 with a history of having had a mild stroke on the right side in March 1954. The diagnosis this time was schizophrenia, paranoid type. She was very delusional and hallucinated. In the hospital the patient was quite disorganized, regressed, hostile, and moderately destructive at times. Because of the recent stroke, electric shock therapy was felt to be contraindicated. In July she was started on Thorazine medication, receiving 50 mg. twice daily by intramuscular injection since she was too disturbed and uncooperative to oral medication. By the 4th day of treatment she started to take medication orally and was given 50 mg. q.i.d. in addition to injections. By the 13th day of treatment she was completely on oral medication. She received 200 mg. of Thorazine daily until the 18th day. At that time the dosage was gradually tapered off and on the 35th day of treatment was stopped. Two weeks later patient was discharged from the hospital as improved.

*C. W., Case 2.* A 63-year-old white female, was admitted in May 1954. The acute onset of her symptoms had occurred about 2 weeks previously. At that time she began to display an obsessive worry about a sister who had been sick for several weeks, and the patient became increasingly agitated, pacing the floor continuously. She expressed fears of being alone, appeared to be confused, and was becoming more withdrawn. The background data

revealed that she had been an obsessional-type person. She had been diabetic since 1947 and had cooperated very poorly in the management of her diabetes in recent weeks.

On admission to this hospital she was agitated, sleeping poorly, and crying a great deal. She attempted to run out of the admitting office, refused to answer any questions and was very disturbed. She continued to be increasingly disturbed, displayed a great deal of anxiety, was preoccupied, kept crying continuously, and her blood pressure had risen to 220/110. Because her diabetic condition had got out of control, she was transferred to the hospital infirmary. *Impression:* 1) diabetes mellitis; 2) moderate cerebral arteriosclerosis; 3) involutional reaction.

On June 7, 1954, because of the patient's continuously disturbed behavior and her refusal to eat, which necessitated tube feeding with the resultant difficulties in controlling her diabetic condition, and because of contraindications to electric shock presented by this situation. the patient was placed on Thorazine and given an intramuscular injection of 50 mg. that night. She seemed to have a quieter night. On June 8, 1954 she received three intramuscular injections of 50 mg. each, and she was observed to be sleeping in the middle of the afternoon, which was most unusual for her, instead of the restless pacing about. However, she still had to be tube-fed. On June 9, 1954, she ate her breakfast for the first time and her pacing activity had decreased markedly. She related in a more coherent manner to interviews. She spoke of wanting to throw herself out the window and get it over with. She spoke of herself as being ugly, nobody wanting her, and that they are trying to force her to eat. She was observed to be sleeping better at night. She was then placed on a combination of intramuscular and oral medication. On the eighth day when the patient was seen by her son for the first time since being hospitalized, he said that a dramatic change had taken place, and he had been able to talk with her for almost an hour. She continued slowly to improve, feeding herself, taking care of herself, and being much more cooperative. From the 8th to the 10th day she had been receiving 50 mg. intramuscularly and 200 mg. of Thorazine by mouth. On the 11th and 12th day she only received 200 mg. of Thorazine by mouth and from the 13th to the 15th day she received 100 mg. of Thorazine by mouth. On the 16th day, June 22, 1954 her medication was stopped because of the development of a marked urticaria and wheal formation. This was very shortly followed by a macular rash that covered her trunk and extremities. Blood pressure at this time was 105/65. Four days later this allergic reaction cleared up. She continued to maintain her improvement. Two days later, June 24, 1954 she developed a diarrhea which persisted for about 5 days and stopped on June 29, 1954. Eleven days after diarrhea stopped on July 10 she was observed to be becoming jaundiced. (This was now approximately 3 weeks after her medication had been stopped.) The jaundice persisted for about 2 weeks and gradually cleared up. Liver-function tests performed at a later date showed no evidence of dysfunction. She has continued to maintain her improved mental status and was transferred out of the infirmary. At the present time she is taking care of her needs, but is still somewhat withdrawn and tends to be isolative in her relations with other patients and personnel. However, she appears to have made a comfortable adjustment to her ward setting.

*M. C., Case 3:* A married white female, now age 42, was first admitted to this hospital with a schizophrenic reaction at age 35. For the past several years she has been in the hospital continuously. During this time she had a unilateral right amygadaloidectomy performed in 1950. In addition, in the past several years there were approximately 200 electroconvulsive treatments given. The most recent progress note prior to the use of Chlorpromazine (Thorazine—S.K.F.) was dated June 22, 1954 and stated: "In the past six months it has appeared that electric shock treatments do not relieve this patient's periods of acute distress, and some observers felt that electric shock treatments make her less controlled and harder to manage. She has been given no electric shock treatments for the past six or eight weeks, during which time she has had periods of sustained, manageable behavior. These periods last approximately two weeks during which time she will keep clothes on and, in general, is more amenable to ward routines. When she is upset, she must be secluded and at times attacks the nursing personnel, who come into the seclusion room for toileting purposes or to bring her food tray. During these times she is completely nude, grimacing, hallucinating and extremely impulsive, assaultive and confused. In some of these periods, she seems to be in a panic as if she was very much frightened."

On June 24, 1954 the patient was started on Thorazine parenterally, 50 mg., t.i.d. At this time she was in seclusion, very disturbed, attacking personnel, but would eat by herself. Outlined below is a brief behavioristic account of her progress:

Day 1: Sleepy and drowsy most of the day.

Day 2: Noisy and disturbed.

Day 3: Started to take medication by mouth and allowed in the day room, but attacked another patient.

Day 4: Disturbed periods appeared to be becoming shorter. Patient stated that she felt the medication was helping her. At the same time she mentioned she has a fear of groups. It is noted that she is much more cooperative and easier to manage.

Day 6: Spends a great deal of time still sleeping and remains overtalkative and overactive, but is much more cooperative. Her disturbed periods only last about an hour or less. The amount of dissociation that she has displayed appears to be lessening.

Day 7: Managed to stay in the day room for 2 hours, then became noisy and had to be secluded.

Day 8: Spoke to one of the attendants whom she has known for some time for an hour and a half about her past life. This attendant stated that this is the best he had ever seen her even after she had been given electric shock treatments.
Day 9: Still dozing at times.
Day 10: Patient continues to remain quiet, cooperative, and is much better integrated. Dr. R. states that this is the best he has seen her.
Day 11: Patient is calm, is able to discuss herself and events in her past life which led to her hospitalization. The ward physician felt that she would profit a great deal from psychotherapy at this point. However, there was no therapist available.
Day 12: Helping with the ward work, and maintaining her improved status.
Day 13: Patient appears drowsy, depressed, and her injections were reduced to b.d.
Day 16: Patient has been developing small indurations at the sites of injection. Injections were reduced to once daily.
Day 17–Day 19: Complains of feeling drowsy but otherwise no change. Her intramuscular injections were stopped.
Day 20: Patient was observed grooming herself. In day room continues to stay to herself, but remains quiet and cooperative.
Day 21–28: Course remains steady.
Day 29: Was observed to be laughing in an autistic manner; however, she is taking part in ward work and playing in gymnasium.
Day 30: Seems to be becoming more confused. It was discovered that during the night another patient had tried to get in bed with her.
Day 31: Patient was depressed, crying, but could give no clear explanation why she felt the way she did. She mentioned that the ward was more disturbed, and she seemed to be starting to hallucinate more actively.
Day 32: Patient has become very disturbed and had to be placed in seclusion.
Day 33–37: Thorazine is being stepped up to 200 mg. Status remains unchanged.
Day 38: Becoming drowsy again. She has been relatively good about eating and free from soiling and smearing, and is now kept in seclusion mainly because of her assaultive behavior.
Day 39–40: About the same.
Day 41: Much quieter, cooperative and was able to remain out of the seclusion room much longer, but has been drowsy most of the day.
Day 43: Patient is out of seclusion and is going to O.T.
Day 44–46: Patient constantly improving.
Day 48–50: Maintaining her progress, helping out on the ward, going to the dining room for her meals. She made the statement today to the attendant "not to forget to give her her medication because she didn't want to get sick like she was before."
Day 51–85: Has continued to maintain her improvement and was transferred to a better ward. She stated today that she feels she can now express herself without getting too upset whereas before she kept everything inside.
Day 86–90: Maintaining her progress, but seemed a little confused and made the statement that she thinks other patients are talking about her.
Day 91–95: Seemed a little more preoccupied and confused and urinated on the floor one night. When this was pointed out, she said she must have done it in her sleep.
Day 96–98: She seemed to get over this period of confusion and was a little better.
Day 99: Stated that she had had an awful dream and spoke about wanting to go home and work. It was observed that she was taking an interest in her personal appearance.
Day 100: She was observed talking with another patient.
Day 101–125: Has continued to improve and is now on one of the best wards, and is now helping out in the dining room.

## Discussion

This discussion will be limited to the reactions of the patients during their first period of treatment averaging 4 to 8 weeks. The changes in the treatment-free interval and the effects of the re-institution of therapy will be discussed in a subsequent paper.

It was observed that initially, with adequate dosage, all patients display an increasing tendency to spend a great deal more time sleeping and to become much less active, while their appetites seem to improve. At the end of about 10 to 14 days the initial reaction changes into one of three patterns: (a) There is a regression back into the patient's previous pattern of behavior. b) There take place the changes described by Lehmann and Hanrahan (9) with the patient displaying a lack of spontaneous interest in his environment. He tends to remain silent and immobile when left alone and to reply to questions in a slow monotone. Although such a patient at first glance appears heavily drugged, the higher psychic functions are preserved to a remarkable degree, and the patient is capable of sustained attention, reflection and concentration. The drug-like effect gradually wears off depending upon the patient's age (that is, the older the patient, the slower the change) and, with this, the patient begins to take part in activities about the ward and displays a movement toward a better social integration, a lessening of delusional and hallucinatory expressions and a decrease in autistic behavior. c) There is a rather marked and

dramatic change of affect from a very hostile, aggressive, paranoidal reaction to a passive, pleasant and cooperative relationship covering over the psychopathology with a thin but persistent veneer.

It has been our observation that the patients who are going to respond are usually those that display a great deal of affect. Some of our patients who had only a transient response to the medication did not return to the level of their former regression. In the past, regression would have necessitated another course of ECT. In some patients there appeared to be a shortening of the regressive episode, then a move forward toward better ward integration, and a great deal more improvement than one would have anticipated. Apparently the application of Chlorpromazine may play a very useful role in those cases where electric shock therapy has reached a point of diminishing returns.

It has been our observation that several of our patients who have had marked hypochondriac tendencies became less tense and preoccupied with their symptomatology. They have made the statement that they feel much more comfortable. When the Thorazine was stopped, they asked that it be re-instituted. However, the request has not been made with the insistence that is usually associated with a drug addiction.

We have found Chlorpromazine to be a very useful agent in elderly, debilitated patients who are markedly excited and disturbed and who have become feeding and management problems. These patients usually show a rather dramatic response, tending to eat better, have a more restful sleep, and be much more cooperative to hospital care.

As yet, we have had no experiences where we have combined this drug with electric shock and insulin therapies. We have had patients who have not responded to Chlorpromazine and who have gone on to psychosurgery. These patients are being studied closely in an endeavor to evaluate their subsequent course, but as yet there are too few cases to justify comment. Investigative efforts are also being conducted into the combination of Thorazine with individual psychotherapy. Here again, our experiences are so limited that no comment will be made until there is enough data for a report.

In our 75 cases, we have seen three cases of jaundice which cleared up with no residual effects after therapy was stopped. There were two cases of Parkinsonism-like reactions. There have been two cases in which there was an eruption on the skin. This disappeared on cessation of the treatment. Some of the patients complained of becoming constipated. Several patients complained of a dry mouth.

## Summary

The effect of Chlorpromazine (Thorazine) was studied in 75 chronic hospitalized psychotic patients. The maximum dosage used in this study was 400 mg. Marked to moderate improvement was obtained in 25 patients. These 25 patients represented all the diagnostic categories found in the state psychiatric hospital. They were all management problems because of their disturbed, regressive behavior. The response to treatment varied from a dramatic change in a few days to a reaction which only began to take place after 8 weeks of treatment. The patients displayed their improvement by becoming quieter, less tense, less reactive to their autistic thinking, and more amenable to the suggestions and care of the nursing staff. Of these 25 patients, three have been discharged from the hospital, and five now have ground parole privileges. Many of the patients who have shown improvement have shown also a gain in weight.

Three of our cases developed transient jaundice. Three cases developed a transient Parkinsonism-like reaction. There were several cases of dermatological reactions.

It is concluded that Chlorpromazine (Thorazine) has brought about a new and effective approach in the treatment of the chronically overactive psychotic patient, and must be considered an important therapeutic agent in the armamentatrium of the psychiatrist.

## Acknowledgment

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# PHYSIOLOGIC PATHOLOGY IN THE SCHIZOID AND AFFECTIVE PSYCHOSES[1]

SEYMOUR DEWITT LUDLUM, M.D., SC.D.[2]

With statistical analysis by GENEVRA Z. DRISCOLL, M.D.

This paper is intended to show the unity of psyche and physiology and their intimate reactive relationship. We have found that when a person recovers from a psychosis that there is present a different state of the physiologic conditions as well as a return of normal mental power. It has been said that an insanity occurs when stress has been sufficient to demoralize the physiology, and we have found that a recovery from an insanity is parallel with a change in the physiologic pattern.

Paul Weiss (1) has said in his essay on adaptation: "Only after the facts are known is it possible to tell just how much of the adaptedness of a given phenomenon is due to inherited evolutionary prearrangements, and how much to direct adjustive interactions . . . Stress (2) may be responded to by increased resistance or by accommodation, by greater effort or by escape; repetitive stimulation, by sharpening or by dulling of the response."

Barcroft (3) in the Terry Lectures, 1938, quotes Cannon's (3a) paper of 1929, which made a special study of the regulation of the principal properties of the blood. In the form of a table, dividing the effects of temperature, oxygen, cH, glucose, etc., into deficient or excessive results, depending on the amounts of change, Barcroft resolves the matter in these words: "Whatever (4) the responsible disorder, the effects are all mental, or at least involve the brain." And he concludes with these words: "the (5) constitution of the fluids that bathe his cells is most exactly regulated; but also that the most immediate effect of interference with the chemical or physical properties of the blood is impairment of the higher qualities of the brain."

In this paper we want to contribute evidence of chemical and physiologic alterations that go with the change from insanity to sanity. There are distinct differences from Cannon's reactions of fight or flight as occur normally in animals, in that the alterations we find constitute deficiency in adaptation and adjustment, as a consequence of which the fluids that bathe the brain cells become an unadjusted fluid milieu.

This study is based upon clinical observations of patients at Gladwyne Colony and at the Philadelphia General Hospital, and upon accompanying laboratory determinations of certain measurable physiologic traits of these patients. Psychic and physiologic attributes have been recorded through episodes of definite psychoses and in subsequent periods of relative clinical normality.

The entire number of cases upon whom data on the psychic state and some physiologic indices have been recorded is about 4000. From those who have made good clinical recovery, 43 acute cases are available upon whom psychic data and complete physiologic data in both psychotic and recovered condition have been obtained. These cases are analyzed for this study of the insane cases. The immature category includes 30 additional, representative cases of that type who are not known to have had clinical psychoses, and which we designate as the constitutional inferiors.

Our early working hypothesis was that the physiologic indices of our cases as a whole should show characteristic differences when determined in states of relative clinical normality from those determined in states of clinical psychosis. This hypothesis has not been supported by the data, and is now known to have been an over-simplification. As seen in charts 1 and 2 below, the physiologic indices of all the cases when psychically sick do not differ

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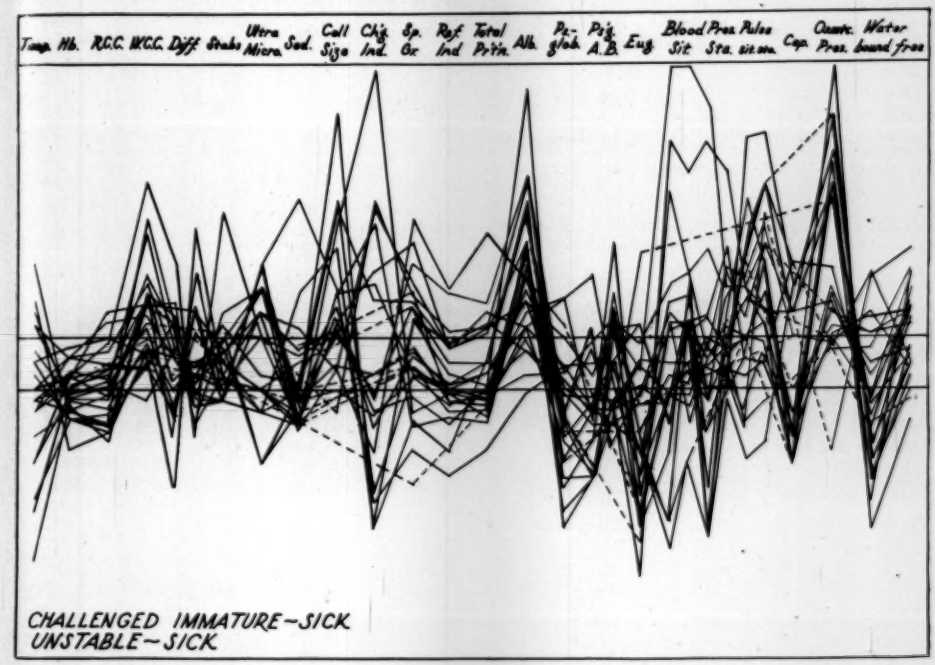
[2] Professor of Psychiatry, Graduate School of Medicine, University of Pennsylvania; Active Consultant, Psychopathic Department, Philadelphia General Hospital; Gladwyne Research Laboratory, Gladwyne, Pennsylvania.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CHALLENGED IMMATURE—SICK
UNSTABLE—SICK

CHART 1. All cases—sick. The heteronegeous profiles of all cases studied are represented when in psychosis.

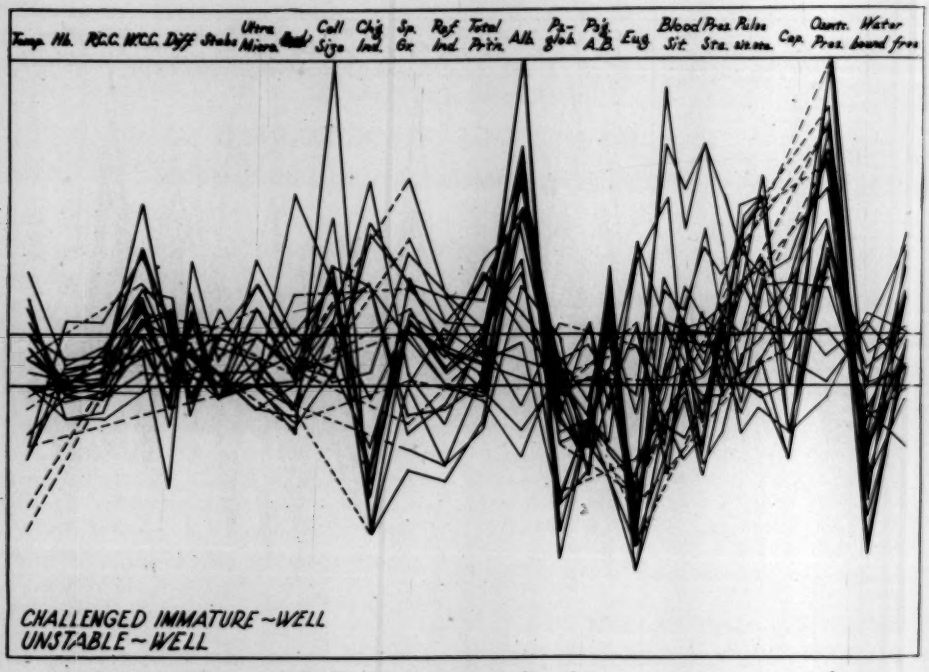
appreciably from the indices of all the cases when psychically well. Inspection of charts 1 and 2 might well lead the observer to conclude that there is no characteristic pathologic physiology in insanity.

However, from study of the individual cases separately, when mentally sick and when well, two characteristic patterns of physiologic traits do emerge. These patterns are notably different. Each type when psychotic shows changes in the physiologic indices characteristic for that type, and different from the other type. Analysis of the data thus led to the recognition within the cases under study of the existence of two principal constitutional types. These types differ from each other during periods of clinical normality; each reacts characteristically and differently in episodes of psychosis. These constitutional types we have designated as: 1) the physiologically immature, and 2) the physiologically unstable.

## The Physiologically Immature Defined

The physiologically immature, when well, present a characteristic constellation of traits which are subnormal with respect to generally accepted standards, but which must be regarded as the normal status for this constitutional type. Characteristically the well immature patients have low body temperature, low blood pressure, low white cell count with accompanying lymphocytosis, slow sedimentation rate, and most important an increase in the albumin fraction with a decrease in the globulin fractions of the serum protein.

The physiologically immature when mentally sick are characterized by rises in body temperature, white cell count, numbers of circulating polymorphonuclear neutrophiles, sedimentation rate and blood pressure; most characteristically there is a lowering of the albumin fraction of the serum protein and an increase either in the euglobulin or in the pseudoglobulin fraction, but with usually a low total protein, and with corresponding changes in osmotic pressure. The altered physiologic traits of the physiologically immature when psychotic are often within generally accepted standards of normality.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CHALLENGED IMMATURE ~ WELL
UNSTABLE ~ WELL

CHART 2. All cases—well. The heterogeneous profiles of the same cases are represented when recovered.

The data presented in this study justify the conclusion, we believe, that the patients in this category are deficient in powers of adaptation or adjustment to stress.

## THE PHYSIOLOGICALLY UNSTABLE DEFINED

The physiologically unstable type shows sick and well patterns of physiologic traits which are the opposite of those found in the pattern of the immature. In the psychotic state the physiologic indices of the unstable type display a pattern of subnormal values, comparable to those of the immature in their recovered or well state. In contrast, the well pattern of the unstable is one closely paralleling the level, in some cases somewhat above the level, generally accepted as the physiologic, standard normal. Comparison of the unstable well state with that of the immature sick state reveals a striking similarity.

Our data, we believe, justify the conclusion that patients of the unstable type are deficient in power to maintain under stress their physiologic adjustment.

Analysis of the data thus leads to the recognition of two constitutional types of individuals who respond oppositely to the challenges involved in precipitating psychosis. The immature type has physiologic traits whose values are normal for those individuals but definitely subnormal with respect to generally recognized norms. In psychosis the indices of the immature type tend to rise to values within limits generally recognized as normal. The physiologic indices of the unstable type when well tend to be within limits generally recognized as normal. In psychosis the indices of the unstable fall to definitely subnormal values.

The psychoses exhibited by individuals of the immature and the unstable types tend to correspond, respectively, to the Kraepelinean categories of dementia praecox and manic-depressive insanity and to the Pavlovian categories which he designates as weak animals and nervous animals.

## Method

The physiologic traits determined are indicated on the tops of charts 1 and 2. They include temperature, pulse rate, blood pressure, sedimentation rate, complete blood picture, and, most important, determination of a number of characteristic fractions of the serum protein. The details of the methods used are appended at the end of this paper. In many patients fluoroscopic studies of the gastrointestinal tract and microscopic observations of the appearance of the capillaries in the matrix of the finger nail were made. These observations are not included because they are not available for all the cases described but, suffice it to say, they show much information relative to autonomic adjustment and morphology.

An individual chart for each patient was prepared by entering the values of each physiologic trait determined at a time when the patient was psychotic, and later the corresponding values determined at a time when the patient was psychically well. The successive points for the sick and for the well states were connected by continuous lines, to give the individual profile diagrams of charts 3 to 9. Composite charts were prepared by superimposing in one diagram the individual diagrams of particular groups as designated in the legends of the charts or in the text.

## Results

The results of the studies are given in the accompanying charts.

Charts 1 and 2 show all the insane cases of the type schizoid and manic depressive, sick and well. Superimposition of the measurements of all patients in psychoses, shown in chart 1, and the same patients in a state of remission or recovery shown in chart 2, does not clarify the picture. The combined physiologic patterns of the sick patients resemble the combined patterns of the well patients, and on the basis of charts 1 and 2 the observer might well feel justified in concluding that there is no characteristic pathologic physiology in insanity.

But by studying these cases separately when mentally sick and when well, two characteristic patterns of physiologic traits do emerge. And they have been found to fall within two principal constitutional types, as already defined, the physiologically immature and the physiologically unstable. The characteristic patterns of traits, respectively, for the physiologically immature when mentally sick and when well, and for the physiologically unstable when mentally sick and when well, were originally defined clearly in composite charts. These patterns have been corroborated in the statistical analysis which follows the clinical exposition. Since the statistical treatment is the more precise, the composite charts for the several groups have been omitted.

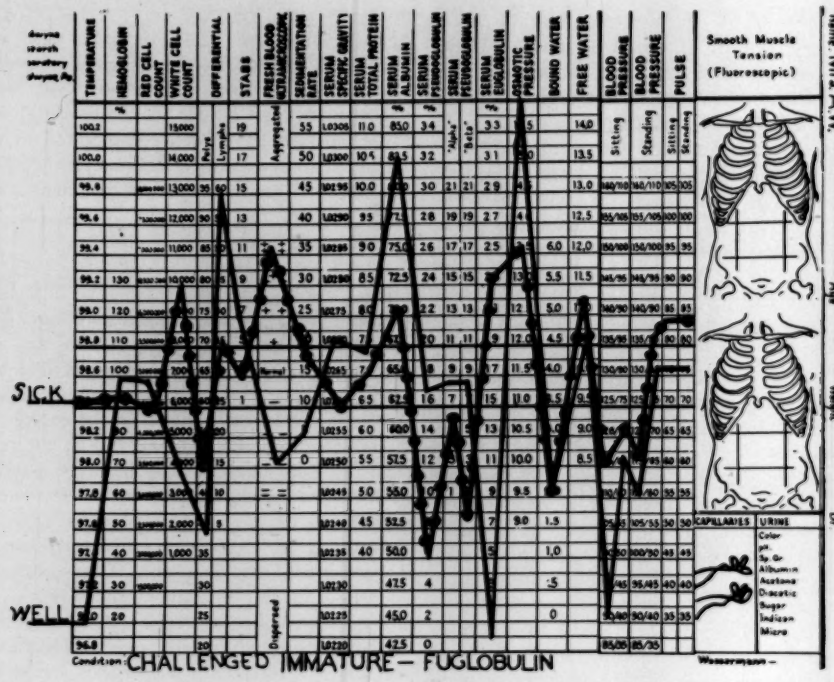
## The Physiologically Immature

In the study of the immature group, it is found that the challenge which precipitates psychotic illness divides the patients into two categories: a) the principal physiologic response to challenge is shown in the euglobulin fraction of the serum protein, and b) the principal physiologic response to challenge is shown in the pseudoglobulin fraction of the serum protein.

Charts 3 and 4 present individual cases of the immature, sick and well. The findings to be noted in the immature when sick (psychotic) are marked by feeble attempts to react in temperature, white cells, polymorphonuclear leukocytes, lymphocyte proportion, sedimentation rate, and blood pressure; and by a lowering of the albumin fraction of the protein and the increase in the euglobulin fraction in one case and in the pseudoglobulin fraction in the other case, and with corresponding osmotic difference. The ultramicroscope shows the red cells tending to aggregate. Our studies have demonstrated that the response of the immature type, in psychosis, to challenge, is inadequate to overcome that challenge, and supportive treatment is necessary to build resistance sufficient to enable these cases to pass through successfully the crisis state and return to recovery.

In wellness of the immature it is notable that there is a reversal in all these factors: a lowering of the temperature, lower white cell count, with an accompanying lymphocytosis, a lowered blood pressure, slowing of the sedimentation rate and an increase in the albumin fraction with a decrease in a globulin fraction of the serum protein. Under the ultramicroscope the cells tend to dispersion. In our belief there is, in these cases, an inherent constitutional weakness which is responsible for their

CHART 3. Challenged immature—euglobulin high. Patient sick, —.—.—.—. Patient well, ————.




| *Date and Condition* | *Total Protein (gm.)* | *Albumin (gm.)* | *Pseudo-Globulin (gm.)* | *Eu-Globulin (gm.)* | *Albumin (%)* | *Pseudo-Globulin (%)* | *Eu-Globulin (%)* | *Osmotic Pressure (Adair)* | *Blood Pressure* |
|---|---|---|---|---|---|---|---|---|---|
| Sick | | | | | | | | | |
| 2–9–44 | 7.03 | 5.01 | 0.47 | 1.55 | 71.3 | 6.7 | 22.0 | 13.8 | 115/70 |
| Well | | | | | | | | | |
| 2–23–45 | 7.36 | 6.11 | 1.25 | 0 | 83.0 | 17.0 | 0 | 15.7 | 110/65 |

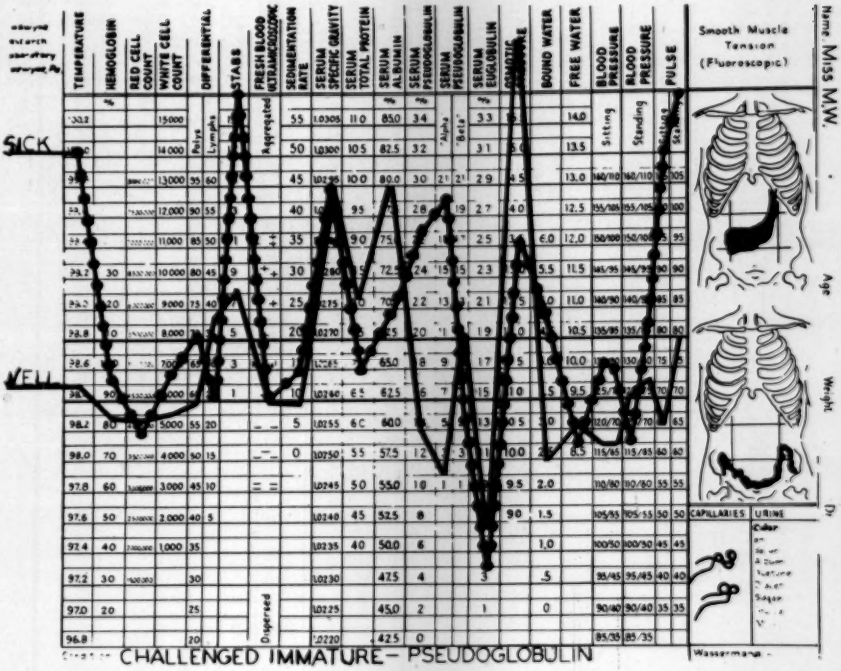
inability to meet the stress of challenge except in a feeble way as described above. The physiologic well picture is quite like the well constitutional inferior, mentioned hereafter.

Chart 3 presents an example of the challenged immature where the physiologic response is marked particularly by a rise in the euglobulin concentration of the serum protein. This physiologic pattern becomes more nearly within the standard normal values, but it is not until these values have returned to the framework of his own particular normal, the immature, that he is well. The physiologic changes demonstrated in this psychosis are an elevated leukocyte count, more polymorphonuclears in relation to the lymphocytes, and aggregation of erythrocytes under the darkfield microscope instead of dispersed erythrocytes. The protein fractionation changed considerably, showing a lowering of the albumin concentration and a rise in the euglobulin.

The elevation of the globulin fraction in the challenged Immature is usually in either the pseudoglobulin or the euglobulin, but not in both, and there is a slightly lower total protein.

Chart 4 exhibits reactivity in the challenged Immature but it is in the pseudoglobulin frac-

CHART 4. Challenged immature—pseudoglobulin high.




| *Date and Condition* | *Total Protein (gm.)* | *Albumin (gm.)* | *Pseudo-Globulin (gm.)* | *Eu-Globulin (gm.)* | *Albumin (%)* | *Pseudo-Globulin (%)* | *Eu-Globulin (%)* | *Osmotic Pressure (Adair)* | *Blood Pressure* |
|---|---|---|---|---|---|---|---|---|---|
| Sick | | | | | | | | | |
| 6–25–47 | 7.03 | 4.85 | 1.89 | 0.29 | 69.0 | 26.9 | 4.1 | 13.6 | 125/70 |
| Well | | | | | | | | | |
| 8–18–47 | 8.23 | 6.58 | 1.11 | 0.54 | 79.9 | 13.5 | 6.6 | 17.2 | 120/70 |

tion of the serum protein, as well as in the high polymorphonuclears and low lymphocytes of the differential.

It is to be noted in wellness that the sane thinking appeared when the level of the physiologic indices was quite the reverse of the level manifested in sickness. It is to be noted further that recovery gives a pattern other than one would expect in a well physiology based on standard norms.

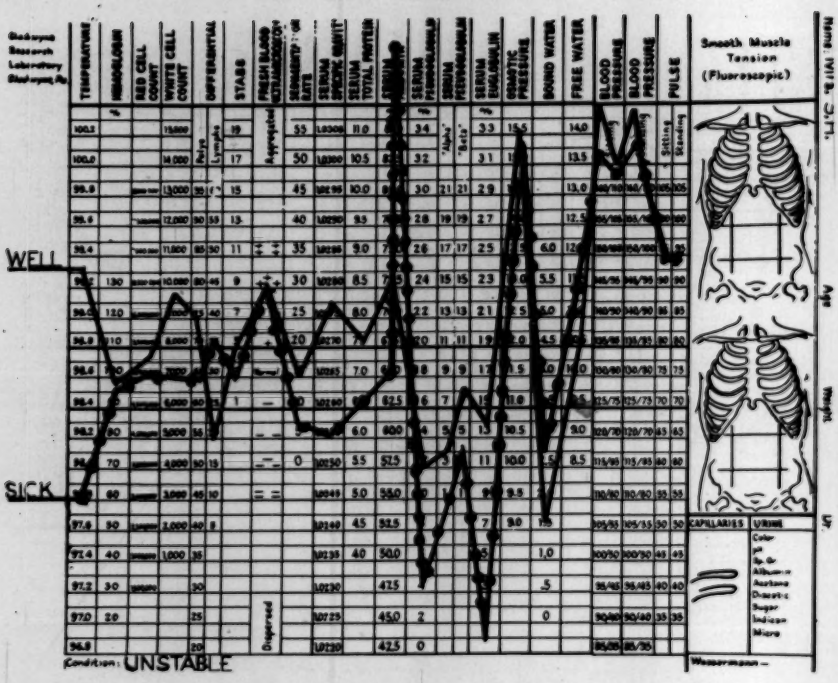
On the 43 acute cases the clinical diagnoses were made of schizophrenia or manic depressive, but in many it was difficult to tell which was the accurate diagnosis, as happens in all clinics. This study has shown that the accurate diagnoses can be made only by doing the physiologic tests. The subsequent clinical histories bore out the differentiations based on the physiologic indices.

## THE PHYSIOLOGICALLY UNSTABLE

Chart 5 illustrates the pattern, sick and well, exhibited by the second group, the unstable.

In sickness the findings are marked by a lowering of the temperature, white count, and a slowing of the sedimentation rate, with an accompanying, dramatic increase in the albumin fraction of the serum protein, and a notable

CHART 5. Unstable.




| *Date and Condition* | *Total Protein (gm.)* | *Albumin (gm.)* | *Pseudo-Globulin (gm.)* | *Eu-Globulin (gm.)* | *Albumin (%)* | *Pseudo-Globulin (%)* | *Eu-Globulin (%)* | *Osmotic Pressure (Adair)* | *Blood Pressure* |
|---|---|---|---|---|---|---|---|---|---|
| Sick | | | | | | | | | |
| 10–12–42 | 6.59 | 6.27 | 0.32 | 0.0 | 95.1 | 4.9 | 0.0 | 15.1 | — |
| Well | | | | | | | | | |
| 12–29–42 | 7.69 | 5.64 | 0.94 | 1.11 | 73.4 | 12.2 | 14.4 | 15.4 | — |

decrease in the globulin fractions, both euglobulin and pseudoglobulin, with a lower total protein.

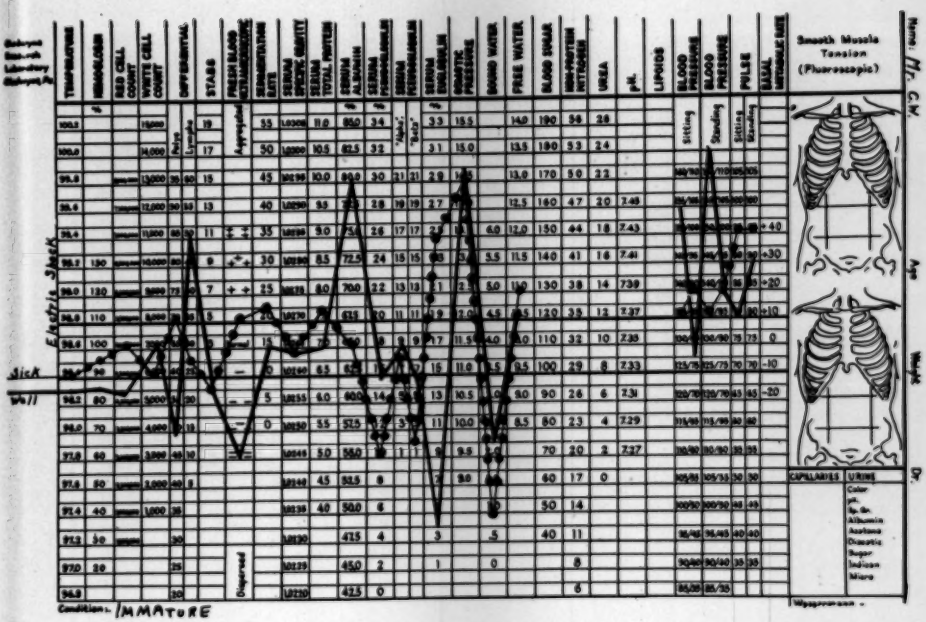
In wellness there is a general reversal of these factors. When well the unstable group has a more nearly standard normal physiology, but it is not able to maintain it, and under stress and challenge, in sickness, it regresses to the physiology of the well immature, and the pattern of the constitutional inferior.

The 12 cases in the group of 43 in their acute clinical states could have been either manic depressive or schizophrenic, but they fell into the physiologic groups here depicted and their future course labeled them as manic depressive.

In the first group, the immature, there is a deficient physiologic adaptability. These people are not able to adapt themselves physiologically to their challenge. The second group, the unstable, do not have the power to maintain the physiologic adaptation that they had in wellness and so they have regressed. In both instances we have a syndrome concerned with biologic adaptability.

We are using tests very similar to those used by Cannon (6) in his work on homeostasis which in this connection could be enlarged to

CHART 6. Electric shock—immature.




| *Date and Condition* | *Total Protein (gm.)* | *Albumin (gm.)* | *Pseudo-Globulin (gm.)* | *Eu-Globulin (gm.)* | *Albumin (%)* | *Pseudo-Globulin (%)* | *Eu-Globulin (%)* | *Osmotic Pressure (Adair)* | *Blood Pressure* |
|---|---|---|---|---|---|---|---|---|---|
| Sick | | | | | | | | | |
| 2–18–44 | 7.69 | 5.01 | 0.79 | 1.89 | 65.1 | 10.3 | 24.6 | 14.5 | 135/90 |
| Well | | | | | | | | | |
| 3–30–44 | 7.03 | 5.64 | 1.10 | 0.29 | 80.2 | 15.7 | 4.1 | 14.7 | 160/80 |

considerable proportions. Apparently, also, there are these patterns of integration which have a definite relation to the logical arrangement of thoughts.

This is not the same as Selye's (7) conception of diseases occurring as a result of too much effort at adaptation, which produces hypertensions, etc., but it is closely attuned to his theories of diseases of adaptability in that these cases have a definite weakness of adaptation.

In toxic cases, not included in the present study, we do find frequently cases that embody the idea of Selye of the general adaptive syndrome. They have mixed toxic symptoms and as they progress there develops a hypertension and a kidney disorder.

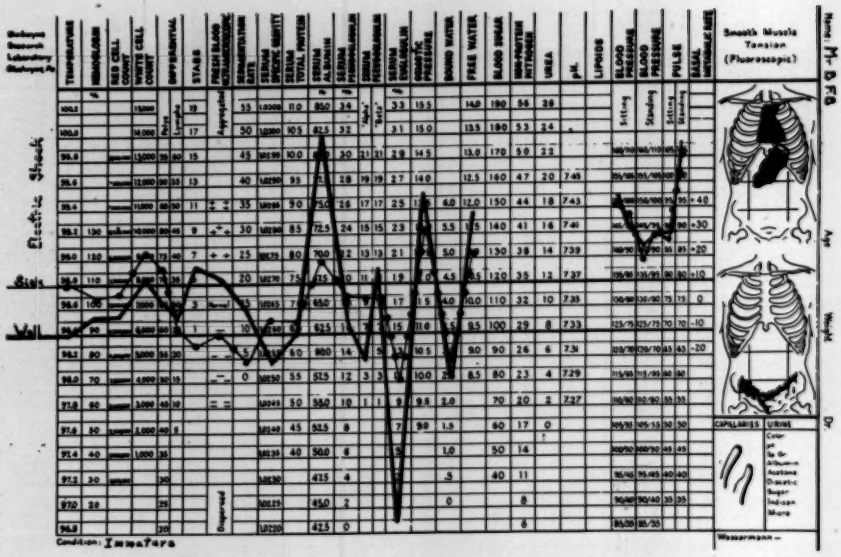
## ELECTRIC SHOCK

Electric shock contributes to the proof of the thesis herein developed. With electric shock treatment we find after a few applications a reversal of the pattern of physiologic traits.

Charts 6, 7, 8, 9 show four cases restored by electric shock. It will be noticed that on recovery they reverted to a type of pattern opposite to that noted in sickness and in which their minds functioned normally. The immature returned to the immature pattern; the unstable reverted to its normal.

In animals that are experimented with in the work with conditioned reflexes, Kessler and Gellhorn (8) say that electric shock erases their new conditioning and they revert to the

CHART 7. Electric shock—immature.




| *Date and Condition* | *Total Protein (gm.)* | *Albumin (gm.)* | *Pseudo-Globulin (gm.)* | *Eu-Globulin (gm.)* | *Albumin (%)* | *Pseudo-Globulin (%)* | *Eu-Globulin (%)* | *Osmotic Pressure (Adair)* | *Blood Pressure* |
|---|---|---|---|---|---|---|---|---|---|
| Sick | | | | | | | | | |
| 1–31–44 | 6.70 | 4.69 | 1.26 | 0.75 | 70.0 | 18.8 | 11.2 | 13.1 | 145/95 |
| Well | | | | | | | | | |
| 3–11–44 | 6.48 | 5.32 | 1.11 | 0.05 | 82.1 | 17.1 | 0.8 | 13.7 | 145/95 |

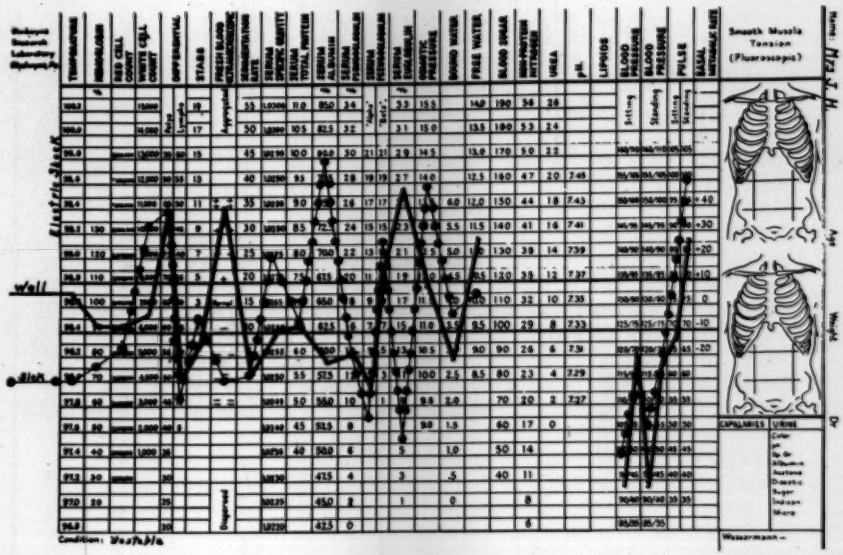
original integrations, which is somewhat like what we have in these cases; if one were to assume the possibility that the psychotic situation was kin to an effort at new conditioning it would be a quite perfect parallel.

## THE CONSTITUTIONAL INFERIOR (PHYSIOLOGICALLY IMMATURE)

By the use of these analytical methods notable relationships are observable in studies of the constitutional inferior. The basis for selection of the 30 cases in this study was clinical. All of the cases showed the clinical symptoms of the constitutional inferior. None of them was insane at the time the measurements were made. Some were intelligent persons; some were feeble minded; all showed the clinical stigmata of constitutional inferiority. These individuals sought help because they had difficulties in adjusting to life in the outside world; they were struggling to keep up with others but could not work out their problems in adequate fashion; they were often incompetent.

Chart 10 illustrates the profile of one constitutional inferior, representing this group of cases, which was not included in the graphs of the insane shown in charts 1 and 2 and in the differential analyses of those cases into the immature and the unstable. The Constitutional inferior is a physiologically inadequate person, a type having its own normal pattern, which shows great deviation from any accepted standard normal. This pattern resembles a well picture of a person in the immature group, an inadequate person who, when challenged and

CHART 8. Electric shock—unstable.



| *Date and Condition* | *Total Protein (gm.)* | *Albumin (gm.)* | *Pseudo-Globulin (gm.)* | *Euglobulin (gm.)* | *Albumin (%)* | *Pseudo-Globulin (%)* | *Euglobulin (%)* | *Osmotic Pressure (Adair)* | *Blood Pressure* |
|---|---|---|---|---|---|---|---|---|---|
| Sick | | | | | | | | | |
| 4–16–43 | 6.70 | 5.32 | 0.95 | 0.43 | 79.4 | 14.2 | 6.4 | 13.9 | 100/75 |
| Well | | | | | | | | | |
| 5–18–43 | 6.59 | 3.91 | 0.94 | 1.74 | 59.3 | 14.3 | 26.4 | 11.9 | 90/75 |

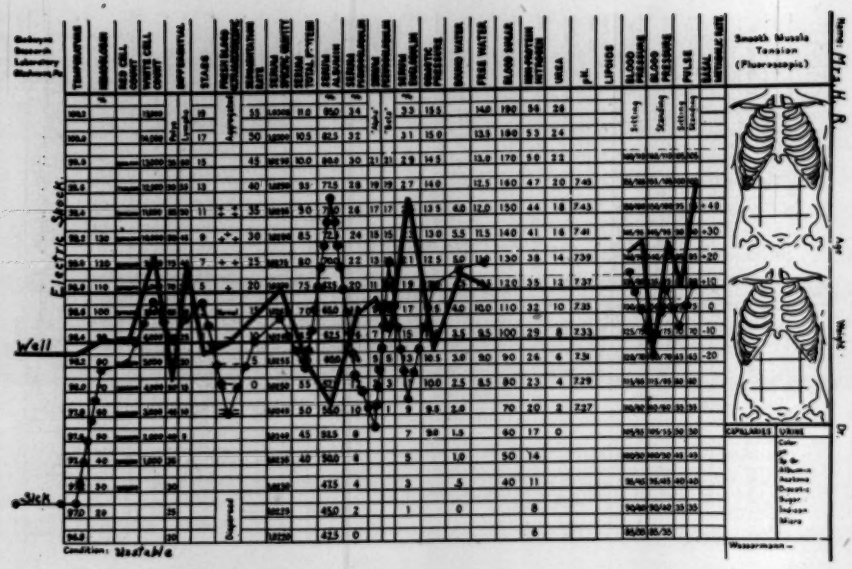
sick, often develops the schizoid type of insanity.

The physiological makeup with which this person lives is dramatically different from the so-called standard normal. A subnormal temperature is typical, as is a low blood pressure. There are usually more erythrocytes, a higher hemoglobin, with a decrease in leukocytes. The difference is predominantly reflected in the relative increase in the lymphocytes, also suggesting a possible inadequacy in the ardrenal cortical secretions necessary for their breakdown. On a darkfield examination of a drop of blood of the constitutional inferior it is seen that the red cells are large and swollen, the while cells usually large, with dispersion of all the cells. The sedimentation rate is also always very low, between 0 and 5 mm. at one hour.

The most characteristic features of this whole physiologic pattern and the ones which change most dramatically with sickness are the serum protein fractionations. The constitutional inferior, as shown here, after long laboratory study, has a high serum albumin concentration, with low figures for pseudoglobulin and euglobulin. This may be causally related with the well known inadequate ability of the constitutional inferior to resist either a bacteriologic or a psychologic challenge.

It is to be noticed that this pattern is the normal for the first group in the insanities which we have noted and described as the immature, and it is also a pathologic regression

CHART 9. Electric shock—unstable.




| *Date and Condition* | *Total Protein (gm.)* | *Albumin (gm.)* | *Pseudo-Globulin (gm.)* | *Eu-Globulin (gm.)* | *Albumin (%)* | *Pseudo-Globulin (%)* | *Eu-Globulin (%)* | *Osmotic Pressure (Adair)* | *Blood Pressure* |
|---|---|---|---|---|---|---|---|---|---|
| Sick | | | | | | | | | |
| 10–23–42 | 6.92 | 5.64 | 0.47 | 0.81 | 81.5 | 6.8 | 11.7 | 14.6 | 135/85 |
| Well | | | | | | | | | |
| 12–15–42 | 8.78 | 6.11 | 1.58 | 1.09 | 69.6 | 18.0 | 12.4 | 17.1 | 150/95 |

for the group secondly noted and described as the unstable.

The constitutional inferior need not develop to insanity, except when challenged. In this group we have found certain forms of folie, crime, and genius, which are described by C. Féré in 1898 (9): "La Famille Névropathique," as "Les aliénés, les criminels et les hommes de génie apportent en naissant une constitution très analogue."

In the feeble minded, in studies with this method, we have commonly found the constitutional inferior pattern; and with the same changes in the serum proteins as are found in the challenged immature when the feeble minded become temporarily psychotic.

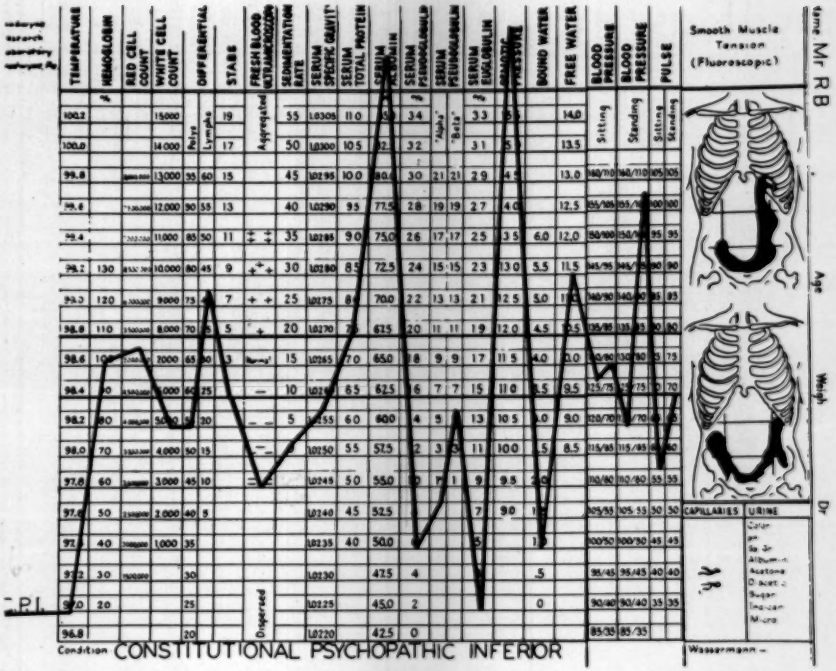
Chart 11 is a multiple graph including 30 cases of the constitutional inferior, showing the predominant appearance of the factors: high percentage of lymphocytes in the differential counts; predominance of subnormal temperature; low blood pressure; slow sedimentation and high osmotic pressure; and high albumin, low pseudoglobulin and euglobulin values in the blood serum with high proportional fraction in the pseudoglobulin-B.

Again, notice that this graph is very similar to that of the immature when well and similar to the sick graph of the unstable.

The constitutional inferior person is the individual who is not insane but whose total psycho-biologic status is such that his conflicts of different kinds cannot be solved by one of the usual ways.

The sensitive constitution plays an important role in the psycho-biology. There are quite

CHART 10. Constitutional inferior.




| *Date and Condition* | *Total Protein (gm.)* | *Albumin (gm.)* | *Pseudo-Globulin (gm.)* | *Eu-Globulin (gm.)* | *Albumin (%)* | *Pseudo-Globulin (%)* | *Eu-Globulin (%)* | *Osmotic Pressure (Adair)* | *Blood Pressure* |
|---|---|---|---|---|---|---|---|---|---|
| C.P.I. 9–8–43 | 7.58 | 7.06 | 0.45 | 0.07 | 93.2 | 5.9 | .9 | 17.2 | 125/95 |

specific hereditary traits that have been established in growth that characterize the individual during the whole development and there is a limit to the changing of traits that cannot be exceeded. These figures should be the criteria of the state of immaturity of the constitutional psychopathic inferior person and should be present in defining a case as constitutional psycho-inferior or immature, for the clinical facts cannot be explained except by assuming that the constitutional type in the case in question is a most important factor in the production of the pathological reactions.

"From the first day of life, however, these dispositions are supposed to be subject to environmental influences and the personality type is, as previously discussed, a result of this interaction. It is, however, quite evident that in the single individual there is a limit to the molding and development of the personality, and this limit must be conditioned by the capacity of the inborn abilities on the one side and the power and nature of the environmental influences on the other" (10).

## STATISTICAL ANALYSIS[3]

The serum proteins of the four groups, 1) psychopathic constitutional inferiors, or immatures who had never been sick, 2) challenged immatures of the pseudoglobulin group,

[3] As prepared by Genevra Z. Driscoll, M.D.

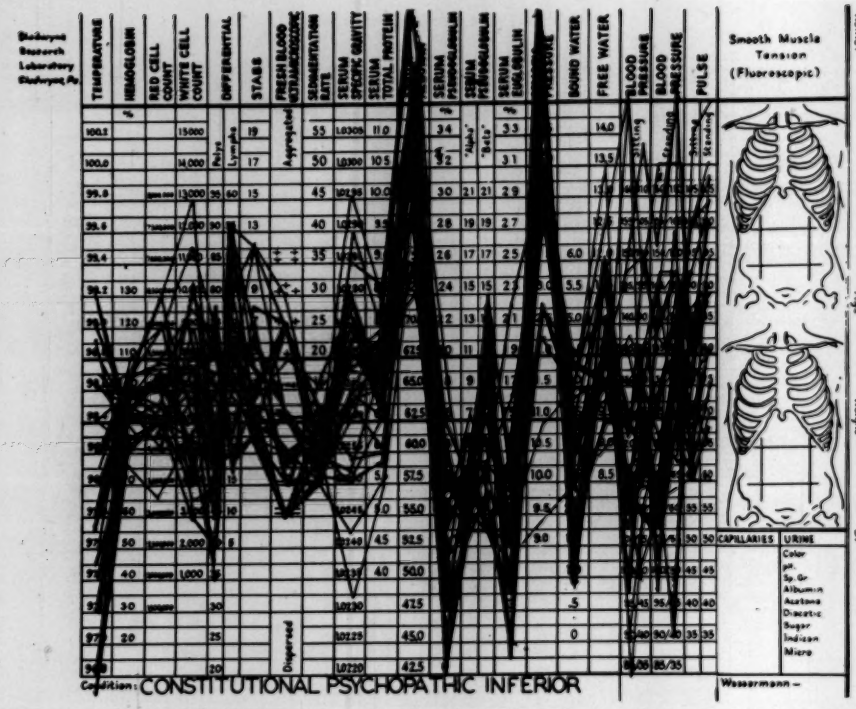



CHART 11. Constitutional inferior (30 cases). The basis for selection of those 30 individual charts plotted collectively as composite chart 11 was clinical. In the group were: 10 morons, 5 feeble minded, 5 defective delinquents, and 10 bright inefficients.

3) challenged immatures of the euglobulin group, and 4) challenged unstables, are compared with normal values of two groups, viz. 1) thirty normals studied by Sunderman and Boerner (11) with the electrophoretic method, and 2) ten normals studied at the Gladwyne Research Laboratory by the same personnel who made the tests on the patients of the study under consideration. The salting-out procedure was used for protein fractionation as outlined by Ludlum.

In table 1 the statistical comparison between these two sets of normal data is presented. Since Sunderman and Boerner had no value listed for the total pseudoglobulin fraction, this component could not be compared.

These figures indicate that the Sunderman-Boerner normals and the Gladwyne normals are in agreement in respect to total protein, albumin, total globulin, and pseudoglobulin B. There is a discrepancy, however, with respect to the euglobulin and pseudoglobulin A, the latter just borderline. (Probabilities of 0.05 or less are significant.) More specifically, the Gladwyne euglobulin normal of 1.21 gm. $\pm$ 0.11/100 ml. is significantly higher than the Sunderman-Boerner normal of 0.2 gm. $\pm$ 0.11/100 ml., while the Galdwyne pseudoglobulin A value of 0.74 $\pm$ 0.13 is significantly lower than the Sunderman-Boerner value of 1.3 gm. $\pm$ 0.23/100 ml. These discrepancies are most probably attributable to the differences in technique. Ludlum notes in the Appendix of this article that the precipitations by the salting-out procedure are not clear cut, and Sunderman and Boerner also discuss this limitation. Still it is noteworthy that the figures compare as favorably as they do. Although the Gladwyne normals afford the better basis for subsequent comparison by virtue of constancy of personnel, techniques, and previous reproducible results with the same patients, both

TABLE I—STATISTICAL COMPARISON OF SERUM PROTEINS OF SUNDERMAN-BOERNER GROUP OF 30 NORMALS AND THE GLADWYNE GROUP OF TEN NORMALS

| *Serum Protein* | *Sunderman-Boerner Group (gm./100 ml.)* | *Gladwyne Group (gm./100 ml.)* | *Difference of Means (gm./100 ml.)* | *Probability †* |
|---|---|---|---|---|
| Total protein ..... | 7.2 ± 0.35* | 7.13 ± 0.20 | −0.07 | 0.9 |
| Albumin ..... | 5.2 ± 0.25 | 4.76 ± 0.12 | −0.48 | 0.1 |
| Globulin ..... | 2.0 ± 0.27 | 2.38 ± 0.13 | +0.38 | 0.12 |
| Pseudoglobulin ... | — | 1.17 ± 0.06 | — | — |
| Pseudoglobulin A.. | 1.3 ± 0.23 | 0.74 ± 0.13 | −0.56 | 0.05 |
| Pseudoglobulin B.. | 0.5 ± 0.16 | 0.43 ± 0.11 | −0.07 | 0.8 |
| Euglobulin ..... | 0.2 ± 0.11 | 1.21 ± 0.11 | +1.01 | <0.01 |

* Standard error.

† Probability that differences in the means of the order indicated could be due to chance alone. Values less than 0.05 are regarded as statistically significant (12).

sets of normal data are used for further comparison with those of the patients of constitutional inferior type, and of schizoid and affective psychoses.

### IMMATURES

In table 2 is a comparison of serum protein values in 30 patients classified as constitutional inferiors, or, as Ludlum names them, immatures who have never been ill, with Sunderman-Boerner normals and with Gladwyne normals.

Here we find an identical picture in the probability columns of both comparisons. The total serum protein does not deviate significantly from either normal, nor does pseudoglobulin B. Albumin in the immatures is significantly higher than either normal, the difference being greater with the Gladwyne comparison. Total globulin is significantly lower in both comparisons, and here again greater in respect to the Gladwyne normal. Pseudoglobulin A is likewise significantly lower in the immatures than either normal group. Euglobulin of the immatures, on the other hand, is significantly high with respect to the Sunderman-Boerner normals but significantly lower with respect to the Gladwyne normals. The wide divergence of the two euglobulin normals make this possible, here and in further comparisons.

In short, all globulins of the immatures in the Gladwyne versus Gladwyne comparison are significantly low except pseudoglobulin B, and albumin significantly higher, although the total serum protein remains within normal limits.

TABLE II—COMPARISON OF SERUM PROTEINS OF IMMATURES WHO HAVE NEVER BEEN SICK WITH SUNDERMAN-BOERNER NORMALS AND WITH GLADWYNE NORMALS

| *Serum Protein Component* | *Mean Values (gm./100 ml.)* | *Comparison with Sunderman-Boerner Normals* | | *Comparison with Gladwyne Normals* | |
|---|---|---|---|---|---|
| | | *Difference of means* (gm./100 ml.)* | *Probability* | *Difference of means* (gm./100 ml.)* | *Probability* |
| Total protein ..... | 7.15 ± 0.12 | −0.05 | 0.9 | +0.02 | 0.2 |
| Albumin ..... | 5.98 ± 0.11 | +0.78 | <0.01 | +1.22 | <0.01 |
| Globulin ..... | 1.17 ± 0.07 | −0.83 | <0.01 | −1.21 | <0.01 |
| Pseudoglobulin ... | 0.60 ± 0.07 | — | — | −0.57 | <0.01 |
| Pseudoglobulin A.. | 0.16 ± 0.03 | −1.14 | <0.01 | −0.58 | <0.01 |
| Pseudoglobulin B.. | 0.44 ± 0.07 | −0.06 | >0.9 | +0.01 | >0.9 |
| Euglobulin ..... | 0.56 ± 0.07 | +0.36 | <0.01 | −0.65 | <0.01 |

* Plus and minus signs indicate that the mean values for the immatures are respectively higher or lower than for the normal comparison groups.

TABLE III—Comparison of Serum Protein Components of 14 Immature Patients of Pseudoglobulin Group with Sunderman-Boerner Normals and with Gladwyne Normals

| *Serum Protein Component* | *Mean Values (gm./100 ml.)* | *Comparison with Sunderman-Boerner Normals* | | *Comparison with Gladwyne Normals* | |
|---|---|---|---|---|---|
| | | *Difference of means* (gm./100 ml.)* | *Probability* | *Difference of means* (gm./100 ml.)* | *Probability* |
| | | *Well Immatures* | | | |
| Total protein .... | 7.23 ± 0.16 | +0.03 | >0.9 | +0.10 | 0.7 |
| Albumin ..... | 6.02 ± 0.21 | +0.82 | 0.02 | +1.26 | <0.01 |
| Globulin ..... | 1.21 ± 0.11 | −0.79 | 0.02 | −1.17 | <0.01 |
| Pseudoglobulin ... | 0.74 ± 0.11 | — | — | −0.43 | <0.01 |
| Pseudoglobulin A.. | 0.22 ± 0.05 | −1.08 | <0.01 | −0.52 | <0.01 |
| Pseudoglobulin B.. | 0.53 ± 0.10 | +0.03 | 0.9 | +0.10 | 0.6 |
| Euglobulin ..... | 0.46 ± 0.09 | +0.26 | 0.1 | −0.75 | <0.01 |
| | | *Sick Immatures* | | | |
| Total Protein .... | 7.19 ± 0.16 | −0.01 | >0.9 | +0.06 | 0.8 |
| Albumin ..... | 5.13 ± 0.14 | −0.07 | 0.8 | +0.37 | 0.1 |
| Globulin ..... | 2.06 ± 0.10 | +0.06 | 0.8 | −0.32 | 0.05 |
| Pseudoglobulin ... | 1.65 ± 0.08 | — | — | +0.48 | <0.01 |
| Pseudoglobulin A.. | 0.73 ± 0.11 | −0.57 | 0.05 | −0.01 | >0.9 |
| Pseudoglobulin B.. | 0.92 ± 0.11 | +0.42 | 0.05 | +0.49 | 0.01 |
| Euglobulin ..... | 0.42 ± 0.09 | +0.22 | 0.2 | −0.79 | <0.01 |

### Challenged Immature—Pseudoglobulin Group

Table 3 shows a comparison of serum protein data from 14 challenged immature patients of the pseudoglobulin group, in their well and sick states with normal values.

In their well phase the picture is the same as that for the unchallenged immatures (see table 2), except for the euglobulin in the Sunderman-Boerner column. In other words, although the total serum protein is of normal proportions, albumin is significantly higher in the well immatures but all globulin fractions are significantly lower, except for pseudoglobulin B, by comparison with Gladwyne normals. In relation to Sunderman-Boerner normals, the above is true except for euglobulin of immatures which is higher but not significantly so. In the sick state, however, we see a shift with a complete reversal in the total pseudoglobulin fraction. As is true throughout this entire study, the total serum protein stays in normal range. Albumin, however, reduces to normal limits by both comparisons, but globulin rises to a value which is only slightly above the Sunderman-Boerner normal and falls on the low borderline of significant difference from the Gladwyne normal. Whereas the total pseudoglobulin is significantly low in the well state, it overswings to a significantly high value in the sick phase. The A and B fractions also are elevated. Pseudoglobulin A goes from a significantly low value in the well patient (by Gladwyne comparison) to a level still lower than normal but within normal limits (and just below borderline with Sunderman-Boerner group). The pseudoglobulin B rises from a normal value in the well to a significantly high figure in both cases. Euglobulin remains approximately the same in the sick and well phases by both comparisons.

In summary, this statistical comparison reveals a group whose protein picture when well shows normal total serum protein, high albumin, low globulins, except pseudoglobulin B. When this group becomes sick, however, the protein picture changes to one normal with respect to total serum protein and albumin, approaching normal with total globulin, swinging high with total pseudoglobulin and pseudoglobulin B, remaining stationary with euglobulin.

TABLE IV—COMPARISON OF SERUM PROTEIN COMPONENTS OF 17 CHALLENGED IMMATURE PATIENTS OF THE "EUGLOBULIN" TYPE IN SICK AND WELL STATES WITH SUNDERMAN-BOERNER NORMALS AND WITH GLADWYNE NORMALS

| *Serum Protein Component* | *Mean Values (gm./100 ml.)* | *Comparison with Sunderman-Boerner Normals* | | *Comparison with Gladwyne Normals* | |
|---|---|---|---|---|---|
| | | *Difference of means* (gm./100 ml.)* | *Probability* | *Difference of means* (gm./100 ml.)* | *Probability* |
| | | *Well Immatures* | | | |
| Total protein ..... | 7.01 ± 0.14 | −0.19 | 0.6 | −0.12 | 0.6 |
| Albumin ..... | 5.69 ± 0.15 | +0.49 | 0.2 | +0.93 | <0.01 |
| Globulin ..... | 1.32 ± 0.12 | −0.68 | 0.05 | −1.06 | <0.01 |
| Pseudoglobulin ... | 0.80 ± 0.06 | — | — | −0.37 | <0.01 |
| Pseudoglobulin A.. | 0.33 ± 0.20 | −0.97 | <0.01 | −0.41 | 0.1 |
| Pseudoglobulin B.. | 0.47 ± 0.08 | −0.03 | 0.9 | +0.04 | 0.8 |
| Euglobulin ..... | 0.51 ± 0.09 | +0.31 | <0.01 | −0.70 | <0.01 |
| | | *Sick Immatures* | | | |
| Total protein ..... | 6.96 ± 0.19 | −0.24 | 0.6 | −0.17 | 0.6 |
| Albumin ..... | 4.97 ± 0.19 | −0.23 | 0.5 | +0.21 | 0.3 |
| Globulin ..... | 1.99 ± 0.13 | −0.01 | >0.9 | −0.39 | 0.05 |
| Pseudoglobulin ... | 0.68 ± 0.05 | — | — | −0.49 | <0.01 |
| Pseudoglobulin A.. | 0.25 ± 0.06 | −1.04 | <0.01 | −0.48 | <0.01 |
| Pseudoglobulin B.. | 0.42 ± 0.06 | −0.08 | 0.6 | −0.01 | >0.9 |
| Euglobulin ..... | 1.31 ± 0.11 | +1.11 | <0.01 | +0.10 | 0.5 |

### CHALLENGE IMMATURE—EUGLOBULIN GROUP

A comparison for another group of 17 challenged Immature patients of the "euglobulin" type is set forth in table 4, to show the relationship of the blood serum proteins when they are sick or well with the normal data of the Sunderman-Boerner and Gladwyne groups.

Here again the picture in the well state is similar to that of the unchallenged immature and the well, challenged immatures of the "pseudoglobulin" group by the Gladwyne comparison except that in addition to total protein and pseudoglobulin B, the pseudoglobulin A. also falls within normal limits. Albumin is significantly elevated; globulin, total pseudoglobulin, and euglobulin are significantly lower than Gladwyne normals. The discrepancy between the pseudoglobulin and its A fraction is attributable to the wide fluctuation of the pseudoglobulin values with a consequent high standard error.

In swinging to the sick phase the total protein of this immature group stays approximately the same and the albumin decreases to normal levels by both comparisons. The globulin rises to normal range of Sunderman-Boerner but not quite to that of Gladwyne. Pseudoglobulin and its A and B components decrease slightly so that total pseudoglobulin is even more significantly lower than the Gladwyne normal. Pseudoglobulin A is significantly low by both comparisons, but pseudoglobulin B remains within normal range throughout. The greatest shift is seen in the euglobulin component, for by the Gladwyne comparison it swings from a very significantly low value when well to normal range when sick. With respect to the Sunderman-Boerner normal there is a corresponding increase in euglobulin but all in the significantly high range.

### CHALLENGED UNSTABLE

In table 5 we find a comparison of the serum protein components of twelve patients with affective psychoses, representing the challenged unstable group, in their sick and well states, with normal data of Sunderman and Boerner and those of Gladwyne.

TABLE V—Statistical Comparison of Serum Protein Components of 12 Challenged Unstable Patients in Their Well and Sick States with Sunderman-Boerner

| *Serum Protein Component* | *Mean Values (gm./100 ml.)* | *Comparison with Sunderman-Boerner Normals* | | *Comparison with Gladwyne Normals* | |
|---|---|---|---|---|---|
| | | *Difference of means* (gm./100 ml.)* | *Probability* | *Difference of means* (gm./100 ml.)* | *Probability* |
| | | *Well Unstables* | | | |
| Total protein | 7.02 ± 0.23 | −0.18 | 0.7 | −0.11 | 0.7 |
| Albumin | 4.63 ± 0.23 | −0.57 | 0.1 | −0.13 | 0.6 |
| Globulin | 2.40 ± 0.13 | +0.40 | 0.2 | +0.02 | 0.9 |
| Pseudoglobulin | 1.10 ± 0.07 | — | — | −0.07 | 0.5 |
| Pseudoglobulin A | 0.58 ± 0.10 | −0.72 | 0.02 | −0.16 | 0.3 |
| Pseudoglobulin B | 0.53 ± 0.10 | +0.03 | 0.9 | +0.10 | 0.6 |
| Euglobulin | 1.29 ± 0.09 | +1.09 | <0.01 | +0.08 | 0.6 |
| | | *Sick Unstables* | | | |
| Total protein | 6.87 ± 0.17 | −0.33 | 0.4 | −0.26 | 0.3 |
| Albumin | 5.51 ± 0.21 | +0.31 | 0.4 | +0.75 | <0.01 |
| Globulin | 1.36 ± 0.15 | −0.64 | 0.05 | −1.02 | <0.01 |
| Pseudoglobulin | 0.77 ± 0.08 | — | — | −0.40 | <0.01 |
| Pseudoglobulin A | 0.21 ± 0.09 | −1.09 | <0.01 | −0.53 | <0.01 |
| Pseudoglobulin B | 0.56 ± 0.09 | +0.06 | 0.7 | +0.13 | 0.4 |
| Euglobulin | 0.59 ± 0.16 | +0.39 | 0.02 | −0.62 | <0.01 |

When the unstables are well, all their serum proteins fall within normal limits by the Gladwyne comparison while the Sunderman-Boerner comparison is essentially the same as table 1, the comparison between the two groups of normal data.

When the unstable patients become sick, however, their protein picture reverts to a picture almost identical with the well immature groups by the Gladwyne comparison; viz., the total protein and pseudoglobulin B remain approximately the same within normal limits, but the albumin is significantly high above normal while globulin, pseudoglobulin, euglobulin, and pseudoglobulin A are all significantly below normal. With the Sunderman-Boerner comparison this trend is also observed with the exception of albumin which remains within normal range, and euglobulin which is still significantly high; this discrepancy has been noted and explained before.

### Sick and Well Immatures and Unstables

The most significant statistical comparison of this study is set up in table 6 as it shows the differences between the physiological data of the previous groups in their well and sick states so that each patient is his own control, thus presenting the best basis for statistical comparison.

As the challenged immature of the "pseudoglobulin" group passes from the sick to well state, neither the total serum protein nor euglobulin change appreciably, but all the other fractions do so significantly. Albumin increases while total globulin and all the pseudoglobulins decrease. The most significant drop occurs in total pseudoglobulin. A significant increase also occurs in osmotic pressure, but none of the other physiological data show any statistically significant changes, perhaps only trends.

Turning to the columns for the challenged immatures of the "euglobulin" type, we find that although the total protein remains in normal limits, albumin increases significantly while total globulin decreases as the patient becomes well, a picture corresponding to that of the "pseudoglobulin" immatures. With this "euglobulin" group, however, the total pseudoglobulin increases to the borderline of signi-

TABLE VI.—Statistical Comparison between Physiological Data of the Three Groups: 1) Challenged Immatures "Pseudoglobulin," 2) Challenged Immature "Euglobulin," and 3) Challenged Unstables, Respectively, in Their Well and Sick States

| | *14 Patients Challenged, Immatures, Pseudoglobulin* | | *17 Patients Challenged, Immatures, Euglobulin* | | *12 Patients Challenged, Unstables* | |
|---|---|---|---|---|---|---|
| | *Difference of means* | *Prob.* | *Difference of means* | *Prob.* | *Difference of means* | *Prob.* |
| Serum protein | | | | | | |
| Total protein | *+0.04 | 0.9 | +0.05 | 0.8 | +0.15 | 0.5 |
| Albumin | +0.89 | 0.02 | +0.72 | 0.02 | −0.88 | 0.02 |
| Globulin | −0.85 | 0.01 | −0.67 | 0.01 | +1.04 | 0.01 |
| Pseudoglobulin | −0.91 | <0.01 | +0.12 | 0.3 | +0.33 | 0.2 |
| Pseudoglobulin A | −0.51 | 0.02 | +0.08 | 0.4 | +0.37 | 0.05 |
| Pseudoglobulin B | −0.39 | 0.05 | +0.05 | 0.5 | −0.03 | 0.8 |
| Euglobulin | +0.04 | 0.8 | −0.80 | 0.01 | +0.70 | 0.02 |
| Osmotic Pressure | +1.71 | 0.02 | +1.15 | 0.05 | −1.03 | 0.1 |
| Bound $H_2O$ | −0.85 | 0.5 | −0.184 | 0.6 | +0.0713 | 0.9 |
| Free $H_2O$ | +0.11 | 0.8 | +0.156 | 0.6 | −0.281 | 0.4 |
| Blood Pressure | | | | | | |
| Sitting systolic | +0.08 | 0.9 | +5.9 | 0.2 | +7.3 | 0.4 |
| Sitting diastolic | −2.6 | 0.5 | −0.13 | 0.7 | +2.2 | 0.5 |
| Standing systolic | +2.4 | 0.6 | +2.3 | 0.6 | −3.3 | 0.6 |
| Standing diastolic | −5.0 | 0.3 | −1.7 | 0.3 | −2.6 | 0.5 |
| Pulse | | | | | | |
| Sitting | +0.85 | 0.9 | −3.25 | 0.6 | −0.58 | 0.9 |
| Standing | −3.69 | 0.5 | −6.67 | 0.4 | −3.18 | 0.5 |
| Temperature | +0.09 | 0.8 | +0.04 | 0.9 | +0.23 | 0.2 |
| Hemoglobin | −1.86 | 0.5 | 0 | >0.9 | +6.25 | 0.05 |
| WBC | −0.995 | 0.5 | −60 | >0.9 | −167 | 0.8 |
| RBC | −1.28 | 0.4 | +0.025 | 0.9 | +0.208 | 0.2 |
| Differential | | | | | | |
| Polys | −5.08 | 0.1 | +2 | 0.6 | −2.6 | 0.5 |
| Lymphs | +4.75 | 0.1 | −0.75 | 0.9 | +3.4 | 0.4 |
| Stabs | +0.08 | 0.9 | −0.06 | 0.9 | −1.8 | 0.1 |
| Sedimentation rate | −0.11 | >0.9 | +1.24 | 0.2 | +2.58 | 0.2 |
| Specific gravity | − .00003 | >0.9 | − .00025 | 0.5 | +0.00035 | 0.5 |

*Signs are directional from data of patients when sick; therefore, + indicates higher than sick value, — indicates lower than sick value.

ficance, while the A and B components increase only within normal limits. The most significant change occurs in the euglobulin fraction, for it decreases significantly as an immature becomes well, or, in reverse, euglobulin increases significantly as he becomes sick. Here again the osmotic pressure is significantly elevated in the well phase, but the remaining data do not fluctuate beyond normal range.

Finally the comparison of the unstable group shows no significant changes in total serum protein, total pseudoglobulin, or pseudoglobulin B, as the patients pass from the sick to the well state. The albumin, however, decreases significantly, euglobulin and pseudoglobulin A increase significantly, but total globulin increases most significantly of all. The osmotic pressure correspondingly decreases, but not significantly so. Of the remaining data, only the hemoglobin increases significantly in the well state. Changes in the other physiological components fail to go beyond limits of normalcy by statistical standards.

## Conclusion

A statistical analysis of the mass of data

gathered for the article "Physiologic Pathology in the Schizoid and Affective Psychoses" has been presented.

Two sets of normal serum protein data from studies by Sunderman and Boerner and at Gladwyne are compared.

These in turn are used in comparison with serum protein values of patients of the following groups: 1) 30 immature patients who had never been sick ("constitutional inferiors"), 2) 14 challenged immatures of the "pseudoglobulin" type (schizoid), 3) 17 challenged immatures of the "euglobulin" type (schizoid), 4) 12 unstables (affective psychoses).

The data of groups 2, 3, and 4 in both their sick and well states are compared with normal values.

Finally a comparison between physiological data of the sick and well states of groups 2, 3, and 4 is given.

Acknowledgment is made to Dr. Julius H. Comroe and Dr. Stella Botelho of the Department of Physiology, Graduate School of Medicine, University of Pennsylvania, and to Dr. Stuart Mudd, Department of Microbiology, School of Medicine, University of Pennsylvania, for their help and guidance in this analysis.

## Discussion

We published cases in 1938 and 1939 (13) on the protein fractionations as non-reactors and hyper-reactors, and we called attention to the similarity of these physical deviations to the immunity reactions in horses being immunized to diphtheria; those horses that cannot make the immune reactions, those that can, and those that make too much. We pointed out then that those persons with schizoid psychic reactions were possessed of low globulin blood serum percentages and high albumin percentages. We also pointed out that there was a hyper-reactor group with low albumin and high globulin serum fractions.

Since that work was done (13a), we have found that what we called the hyper-reactor as an entity was really the sick phase of the non-reactor. The immature non-reactor shows high globulin and a bizarre reactivity which is not adequate for recovery when challenged.

In order to work out a better understanding of this psychophysical relationship, we have studied each individual case sick and well, and we have charted the individual differences and so determined the physiology associated with relatively good adjustment and that with psychosis in the two groups.

A basic fact in this research in insanity is that the orderly arrangement of the constituents of the mind is found to be correlative with a likewise orderly integration of the physiology of the individual. Disorder of the psyche and deviation of the physiologic indices from the status normal for that individual appear at the time when with sufficient stress or strain the physiologic integration becomes disordered. The individual is suffering from inadequate effort at adaptation and with effects observable in the integration of the nervous system. And a crucial test of a mental recovery is: has there been a remission of all the pathologic physiologic factors characteristic of the psychotic state.

We have presented evidence that there is a definite, measurable physiolgic pathology in insanity just as there is pathology in other branches of medicine. There is a definite physiologic level correlative with sanity and another accompanying insanity. There are notable physiologic changes during recovery and there emerges when psychically well a physiologic pattern that represents the physiologic limits for the individual in question within which the performance of rational thinking occurs.

Lillie (14) has said: "The separate consideration of its physical and psychical aspects may be compelled by the requirements of scientific observation and description; but this does not mean that the physical and the psychical in reality correspond to two distinct realms of existence, different in kind and capable of acting in entire independence of each other. Rather, they are to be regarded as existing and acting in an inseparable unity." This can be elucidated by examining the state of the physical when the mind is in a different state from its usual state but in the same body, i.e. is insane.

We feel that a great deal of the difficulty in research in the past has been in our search for special tests and because, in these insanities, we have these opposite pathologies which are masked when the total number of cases is considered as a single group. Results we have

seen published are not conclusive because the type of reactivity of the individual was not determined before the statistics were made up. Frequently the same test is made on a number of individuals and the results averaged, thereby nullifying any differentiation. All studies should be made with a view to differentiation among individual cases and integration of cases in appropriate categories.

When Pavlov (15) writes about the dogs that are susceptible to nervous disorders he says: "Among dogs, those most rapidly and readily developing nervous affections as a result of hard experimental conditions are animals belonging to the two extreme types: the excitable and the weak types." (Quite like the unstable and immature people.) "Of course by applying extremely strong and excessive measures it is possible to disturb even the equilibrium of animals belonging to the strong and well-balanced type. The hard conditions which chronically disturb nervous equilibrium consist in the overstraining of the excitatory process, in the overstraining of the inhibitory process and in the direct collision of both these opposed processes, or in other words in the overstraining of the mobility of these processes."

"A neurosis (16) displayed by the weak type of dog is almost exclusively of a depressive nature. The conditioned reflex activity becomes very disorderly and, most frequently, entirely disappears."

From reading Pavlov it may be assumed that proper associations take place only when excitation and inhibition irradiate in the same way that they are used to or that is normal and undisturbed for the individual: and we would like to add that the proper associations take place only when the physiologic conditions are in the status that we have found to be present when the individual is psychically well. It appears to us that the conditioned reflexes are an essential part of the machinery of biologic adaptation.

This subject is not well stated without quoting again from Joseph Barcroft's Terry Lecture (17), "The Brain and its Environment": "I wish now to enumerate some of the principal properties of the blood and to consider what is the effect of altering any one of these to an appreciable extent. The body temperature may be too low or too high. The oxygen contained in the plasma of the blood may be too high in concentration or too low; the same is true of the carbonic acid, the alkalinity, the sugar, the salt, and so on." And, arguing from Cannon's work on homeostasis and his own experiments, he comes to say (18), "It would seem, therefore, that in the case of oxygen concentration there is simply a certain optimal concentration in the blood plasma, that to which we are accustomed, and that if there is any gross departure from this on either side the higher functions of the brain suffer, leaving the lower ones either to run riot or to flag, as the case may be."

As his experiments are further written concerning other constituents of the blood he summarizes with (19): "We have therefore arrived at the point where we can say not only that the form of life—man—which has developed an intellectual power far beyond any other, is that in which the constitution of the fluids that bathe his cells is most exactly regulated; but also that the most immediate effect of interference with the chemical or physical properties of the blood is impairment of the higher qualities of the brain."

It would seem, the physiologic types that we have described fulfill the requirements of Pavlov and of Barcroft in that to permit normal psychic functioning it has been shown that the original conditioning and original physiology must be returned to the optimal conditions to which they were accustomed.

As a tribute to Kraepelin, the cases herein described follow quite closely his categories of dementia praecox and manic depressive disease. It is interesting that Kraepelin saw so clearly clinically what we now find to be true physiologically.

But we should not be satisfied with the psychologic diagnosis of schizophrenia or manic depressive insanity unless the physiologic pathology demonstrates that it is one of those cases; for we have seen many cases of the immature type which have periodic recurrences but which are not manic depressive, and a study of the physiology makes it possible to determine accurately which psychic form is being dealt with.

We consider that we have dealt with two types of constitutional weakness and with their

subnormal physiologies and their limited power of adjustment to stress. That stress may be psychologic or environmental in many cases; in others it may be infection somewhere in the body, or faults in the menstrual cycles, or some other dysfunction. We have dealt with the mechanism which is present in all these cases of Schizoid and affective insanity, a mechanism which is operative in all forms of stress; a mechanism of the weakness and deficiencies of adaptation in mental disease.

## Conclusion

All of the work in this study has gradually led to the recognition of different types of nervous activity, depending upon the varying homeostasis, measurable as physiologic adaptability.

The constitutional inferior or physiologically immature organism has a definite profile of physiologic inadequacy. When this type of individual is subjected to too much stress of any sort, there are abortive attempts at reaching physiologic equilibrium, particularly in the serum globulins. It is this attempt at adaptation that is synchronous with the precipitation of the insanity.

In the immature, or schizoid, type, when well the figures take the physiologic profile of the constitutional inferior. In the very sick immature individual the serum protein figures usually seem to be within standard normal proportions, but this is misleading. The figures are the evidence of challenge and inadequate effort at adaptation.

In the unstable, or manic depressive, type, when sick there is a reversion of the physiology of the physiologically immature, and with this reversion there appears an insanity. When sane thinking appears the physiologic status is reversed from that observable in the insane and this reversed pattern can be considered as the individual's normal or possibly his original constitutional pattern. This physiologic profile makes quite a standard normal picture.

The recognition of the type of activity of a nervous system can be determined by the study of the physiologic adaptability.

We do not know yet why the body reactivity does not function adequately, as in the physiologically immature person; possibly it may be genetically explained, with a poor nervous system, with poor integration, with an endocrine background. This poor reactivity lays the personality open to many derangements by environment, or infection, or other stress.

In the consideration of these points of the equilibriums that are the physiological adaptations there is a means of measuring the ability to meet stress.

## Appendix Explaining Laboratory Procedure

The erythrocyte and leukocyte counts were taken using standard pipets and solutions. The enumeration of the cells was made with a Levy counting chamber with Neubauer ruling.

The hemoglobin determinations were made by diluting 0.05 cc. of blood in 10 cc of 0.1 per cent sodium carbonate and reading in a Leitz-Mass Clinical Photo-Electric Colorimeter.

The sedimentation rates were determined using a Wintrobe hematocrit tube. Potassium oxalate was the anticoagulant employed and readings recorded are for one hour.

Special precaution was taken in temperature determination in that no arbitrary time limit was employed. The thermometer was returned, repeatedly, as necessary, until two readings which were the same were obtained.

The total protein and fractional protein determinations forming the basis of the differentiation of the protein content of the serum of the individuals studied in this report were done by a modified method, using the principle of the separation of mixed proteins in solution (e.g. serum) by increasing strengths of salt solution. This procedure was originated by Howe (20). The saturated salt solution used (22.5 per cent $Na_2SO_4$ in $H_2O$) precipitates all the globulins, while the weakest solution used, 16.1% $Na_2SO_4$, precipitates the higher melecular weight euglobulin.

The same technique of precipitation and separation was used throughout the determinations reported here, and the protein in the separated fractions and the total protein were obtained by a determination of the nitrogen present by the standard Kjehldahl-Gunning method and this N multiplied by the standard general factor 6.25 to obtain the amount of protein represented.

The total protein in each specimen of serum was determined directly on the unprecipitated

serum. It is convenient to dilute the serum ½ cc. serum to 12.0 cc. of 2 per cent NaCl-$H_2O$ sol., using a 10 cc. aliquot for determining N by the same Kjehldahl-Gunning method and converting the N to protein by multiplying by the factor 6.25 and then by the proper factor to bring the calculation to the strength of original serum.

In the fractional protein determination used in this report six strengths of solution were used in the proportion of 17.5 cc. of each to ½ cc of serum. There were as follows:

I. 22.5% precipitates Eug + PsB2 + PsB1 + PsA2 + PsA1 Albumin in solution
II. 20.9% precipitates Eug + PsB2 + PsB1 + PsA2
III. 19.3% precipitates Eug. + PsB2 + PsB1
IV. 17.7% precipitates Eug + PsB2
V. 16.1% precipitates Eug
VI. 14.5% precipitates presumably no euglobulin. (There is evidence that a still higher globulin, eug B, may precipitate here when present.)

In these separations the precipitate is filtered off and the N in the filtrate is determined as above and converted to equivalent protein.

It is our custom to use both the percentage of protein in each of these fractions as found by subtraction from the preceding precipitation, and having those separate fractions to calculate the proportional percentage of each in the total protein present.

It is not claimed that this separation is sharp and absolute, because some of these fractions tend to redissolve somewhat at concentrations above or below their concentration of least solubility; but the results are comparable and give results which on bloods from the same individual at different times, and from different individuals, do yield fractional protein pictures which are reproducible and characteristic, and which show a definite relationship to other clinical findings and measurements on the individual.

There is evidence also that in certain individuals they may fail to build their globulin molecules in some of the fractions to as high as the typical globulin of the fraction represented, and also it is true that in some serum more or less of what may be called euglobulin-B is present and will yield a precipitate in the No. VI solution which is not supposed to precipitate the typical euglobulin-A.

The essential consideration, in this connection, is that this method of separation has been found to yield results which are reproducible in the same individual and which yield fractional amounts of protein that give fractional protein pictures from each serum which are comparable between themselves. These pictures also correspond with changes in the clinical picture of the metabolic condition as indicated by ordinary clinical observation and measurements.

Other methods used in this laboratory have been published (21).

In the matter of the protein determinations, we do not feel that the methods using color determinations with the electric colorimeter are reliable. No matter what one would say regarding the Kjeldahl-Howe method, the fact that the method demonstrates definite differences in such and such conditions when done by the same experienced person has a definite differential value. All tests were made by the same personnel under standard conditions, and the results are strictly comparable.

The work leading up to this paper has been developed over a number of years and contributions have been made in our Laboratory by Dr. A. E. Taft, Dr. Ellice McDonald, Dr. Robert L. Nugent, Dr. Wilder D. Bancroft, Dr. Vera Koehring, Dr. José Zozaya, Dr. R. L. Lichtenthaeler, Mrs. Elizabeth Burt Byall, Mrs. Emily Mudd Chapman, and, my secretary, Miss Alice H. Stewart.

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# ON THE RELATIONSHIP BETWEEN "NORMAL" EEG PATTERNS AND PERSONALITY VARIABLES[1]

BOYD D. SISSON, PH.D., AND ROBERT J. ELLINGSON, PH.D.

In a 1949 paper (22) Saul, Davis, and Davis presented several "empirical propositions" concerning relationships between normal EEG patterns and certain personality characteristics. They derived these propositions from studies made some ten years earlier, a preliminary report of which was published in 1937 (21).

Specifically, a relationship was proposed between alpha index (the percentage of time that a readable alpha rhythm is present in the EEG of a relaxed, waking subject) and a passivity dimension of personality, such that passive individuals tend to have regular, persistent alpha rhythms of high index, whereas "masculine competitive" individuals tend to have low voltage, weak alpha rhythms of low index. *Passivity* was defined as connoting "dependence, submissiveness, the desire to receive from others, and readiness to retreat from dangers, effort, and responsibility. The meaning of the term can be defined further by contrast with the antithetical constellation of independence, drive, dominance, activity and masculinity."

A relationships was also proposed between irregularity of EEG pattern and personality, especially among women: "it is the *frustrated, demanding, impatient, aggressive, hostile women* who have the *MF* or *M* type of EEG" (italics theirs). The Davises' *M* (mixed) type EEG is characterized by alpha voltage of 25-75 $\mu$V, an alpha index usually between 25 and 65, and the presence of other waves both faster and slower than alpha. Their *MF* (mixed fast) type EEG is characterized by an alpha rhythm usually over 10.5 cps. in frequency and the presence of waves faster than alpha.

Perhaps because the terms of the first proposition are more clearly defined, it has been more frequently cited in the literature, and it appears to have been more or less accepted as demonstrated. We have undertaken a critical review of the evidence upon which it is based. Saul, Davis, and Davis arrived at their propositions in the following way. They divided the EEGs of 66 subjects, predominantly psychoneurotics under psychotherapy, into groups that "looked alike." From their knowledge of the subjects' life histories, present life situations, and psychodynamics, they sought for the psychological characteristics common to each group. Dream analysis was the chief analytical tool.

In 1940 the investigators sought to put their inductions to the test. They employed an additional sample of subjects, who had been, or were, under psychoanalysis. The exact number of cases in this sample is not given. It is at least 26, but may be more. EEGs were recorded and classified. The analyst had no knowledge of the EEG results and the electroencephalographers had no knowledge of the subjects' psychodynamics. Eight tests were then undertaken.

In the first the analyst, without disclosing the identity of the subject, discussed the case with the others. They then independently ranked 6 EEGs (the subject's and 5 others selected at random from the files, presumably by a fourth party) as being most to least likely to be the EEG of the subject discussed. The results appear to have been in the direction predicted, but the data are not given in detail, and available statistical tests (26) were not applied. Apparently not all of the available cases were used.

In the second test one of the electroencephalographers classified 26 EEGs on two dimensions: alpha index and regularity-irregularity. The analyst independently predicted the subjects' positions on the same two scales from his psychodynamic data "according to the prominence of the psychological traits of 'aggressive-frustrated' and 'passive'." Six cases were considered atypical by one, or the other, or both, judges, and dropped. Of the remaining 20, 10 were "in practically identical positions on *both*

[1] From the Neuropsychiatric Service, Veterans Administration Hospital, Omaha, and the Nebraska Psychiatric Institute, University of Nebraska College of Medicine, Omaha, Nebraska.

the high to low alpha (passive to masculine-competitive) scale and on the irregularity (frustrated, hostile, aggressive, impatient) scale. For the remaining 10 there was some disagreement . . . ." Precise data were not given and statistical tests were not applied.

In the third test the analyst selected the "very passive" and "fairly passive" subjects, 17 in all. It was decided to consider an alpha index of 80 or above as "correct" for a "very passive" subject and one of 75 to 80 as "half correct." For a "fairly passive" subject an alpha index of 70 to 85 was considered "correct" and one of 60 to 70 or 85 to 95 "half correct." The resulting correctness score was 14 (17 possible). The probability of obtaining this correctness score by chance alone is unknown. A less arbitrary method would have been to determine by the Chi-square technique whether the distribution of alpha indices for the 17 selected subjects differed significantly from that of an unselected population (the most common indices in the investigators' experience were reported as being 70 to 80). Another method would have been to compare the mean index of the 17 selected cases with the mean index of the cases not selected as passive, using Student's *t*-test, provided the basic mathematical assumptions were satisfied.

The remaining 5 tests, all conducted upon very small numbers of subjects, admittedly lacked rigor since the analyst "had obviously acquired some knowledge of the EEG types of several of the patients from the results of earlier tests." They are consequently not discussed here.

Saul, Davis, and Davis conclude that very passive individuals have EEGs with very high alpha indices. Among the 133 cases in the their series "there were no real exceptions to this rule." They were "not so sure that all individuals with high-alpha EEG's are necessarily passive. There are many obvious *partial* exceptions. Most individuals with high-alpha EEG's successfully handle or compensate for their passive trends, but we are inclined to believe that their *fundamental orientation toward other people* is one of especially prominent passive dependence" (italics theirs).

They further state that *"women with strong masculine trends have low-alpha EEG records. . . .* The situation is less clear for men than for women, but the very few low-alpha men in our series show psychologic problems centering around those trends which we listed above as antithetical to 'passivity' " (italics theirs). This group is treated "with special reserve," because "outside the psychoanalyzed neurotic group *this type of EEG has often been seen in individuals who do not belong to the psychologic type described"* (italics ours).

We find the evidence of Saul, Davis, and Davis for their propositions unconvincing. The uncritical acceptance of their propositions in later, related studies is illustrated in the following.

In 1942 Rubin and Bowman reported an EEG and personality study of 100 peptic ulcer patients (19). Seventy-one of their subjects had dominant-alpha EEGs (alpha index over 75) as compared with 20 of 100 controls from a series collected by H. Davis at the Pensacola Naval Air Station. The difference is obviously significant by inspection. Personality data were obtained in half-hour interviews. Passivity was deduced from work history, parental identification, marital adjustment, childhood attitudes, and attitudes toward friends. Data were incomplete in many cases.

While a control group was used for the EEG data (from a young, service population which surely differed from a group of middle aged, Lower East Side, ulcer patients in many ways), no control group was used for the clinical personality data. It is not clear whether the investigators knew the EEG results when the clinical data were collected.

At one point the authors state that the data are tentative and indicate only a trend. Later they state that their data indicate a definite relationship between peptic ulcer and dominant alpha. They continue: "Dominant alpha records are correlated with passive, receptive, dependent types of individuals. This was determined by the studies of Saul and Davis . . . . Our results indicate therefore, that in peptic ulcer, *by this criterion (high dominant alpha correlation with passive personality)* we have established a close relationship between peptic ulcer and a passive, receptive, fundamental personality structure" (italics ours).

In 1944 Rubin and Moses reported an almost identical study of 45 asthmatics (20). Sixty per cent of their group had dominant alpha

EEGs, as compared again with Davis's Pensacola sample (20 per cent). They state, "Dominant alpha records have been correlated with passive, receptive types of individuals." They refer to the 1937 paper of Saul, Davis, and Davis and to a paper by Lemere (9) in which he concluded, "The ability to produce 'good' alpha waves seems to be a neurophysiological characteristic which is related in some way to the affective capacity of the individual"! Rubin and Moses continue: "Our results would indicate . . . . a close relationship between bronchial asthma and a fundamental passive dependent personality structure *by the criterion of high dominant alpha index correlation with passive personality*" (italics ours). This study is open to the same criticism as the preceding one.

And again in 1946 Moses reported EEG and personality data on 25 duodenal ulcer patients (15). The procedure, results, and conclusions were almost identical with those of the earlier study (19), and open to the same criticisms.

Ostow in a review paper (16) cites the results of Saul, Davis, and Davis, and the papers of Rubin, Bowman, and Moses. He explains their observations on the basis that "the subject who refuses to assume a passive attitude, preferring to think actively . . . will show a low voltage alpha factor, and a subject who surrenders himself to 'passive' thinking . . . . will very likely yield a record with a high per cent time alpha." He concludes in this regard that individual differences in EEG pattern "reflect a personality difference only to the extent that habits of constructive, intellectual function vary."

Harris (7) bases some speculations on neural mechanisms of repression upon a high alpha index-passivity relationship. He cites Saul, Davis, and Davis, the papers of Rubin, Bowman, and Moses, Ostow (!) and Henry and Knott (!).

Levy and Kennard, in a recent study of EEG and personality in a group of 100 penitentiary inmates (10), found 22 per cent "pure alpha" EEGs. Citing Saul, Davis, and Davis and Rubin and Bowman, they state that "such records are of the type that has been associated in the past with a particular kind of passive personality . . . ."

In another paper (11) Levy and Kennard have considered high alpha index, as well as low voltage fast activity, to be abnormal! They further state that criminals and sexual psychopaths showed a *relatively high incidence* of high alpha index (24 and 28 percent, respectively; compare 20 percent for H. Davis's controls!).

Rowntree also appears to accept a high-alpha index-passivity relationship in his review paper (18). We have undoubtedly missed other references to this relationship in the literature, but these are sufficient to demonstrate its currency.

About the time of Saul, Davis, and Davis's preliminary report another relationship between high alpha index and personality was proposed by Gottlober (6), who related high alpha index to extroversion. Henry and Knott pointed out (8) that the group Gottlober studied was loaded with both high alpha indices and extroverts, and with additional data were unable to find a significant relationship between extroversion-introversion and alpha index. Perhaps because of Henry and Knott's prompt rejoinder, Gottlober's notion has never gained currency.

Another approach to the topic under consideration is the use of projective techniques in personality assessment. There have been a few recent attempts to relate Rorschach scoring categories to alpha index.

Travis and Bennett (25) compared a group of 32 normal adults with alpha indices over 50 with another group of 34 with alpha indices under 50 with respect to Rorschach response categories. They found that the group with high indices gave significantly more whole responses (W%), while the low-index group gave significantly more total responses (R), unusual details plus space responses (Dd, S%), color responses (sum C), more absolute whole responses (W), and took significantly more time (T). They concluded tentatively that the high alpha index individuals "possess a passive-receptive manner of organizing stimuli, and reflect the constrictive work of affective factors upon productivity." How these conclusions were deduced from the Rorschach results cited is not clear. Unfortunately the communication is in brief abstract form, precluding the presentation of details of method or a useful discussion.

Brudo and Darrow (2) tested a hypothesis that the incidence of human movement responses (M) to the Rorschach inkblots is positively related to alpha index. Their subjects were 11 normal children and 10 with behavior problems and possible brain damage. Rorschach scoring and alpha-index measurements were done independently. Rank order correlations between M and alpha index were 0.532 ($P < 0.05$) for the normal group, 0.636 ($P < 0.05$) for the other group, and 0.619 ($P < 0.01$) for the combined groups. The correlation between alpha index and total responses (R) was not significant. No other results were reported in their abstract.

We have recently further investigated the relationship between alpha index and Rorschach scoring categories. The method of extreme groups for the selection of cases was used on the assumption that if there are consistent and useful relationships between alpha index and personality, they should be most marked in persons displaying extremely high and extremely low alpha indices. We selected all the records of male patients in our EEG files with alpha indices of over 90 and under 10 within the age range of 17 to 50 on whom Rorschach protocols were available. Only normal EEGs were used. Alpha index was determined in each case by measuring the percentage of time alpha rhythm was present in the first 30 seconds (90 cm.) of right occipital unipolar tracing, which in no case was the first 30 seconds of recording. If inspection indicated that this 30-second sample might not be typical of the EEG record as a whole, additional samples were analyzed.

Only 30 cases met all of these criteria. Fortunately 15 of them were in the high alpha index group and 15 in the low. The age range in each group was 17 to 46. Mean age for the high group was 27.7 (SD 9.8), for the low group 31.9 (SD 10.0); $t = 1.114$ ($P > 0.20$). The high alpha index group consisted of 6 psychotics, 4 psychoneurotics, 4 personality disorders, and 1 neurological disorder; the low alpha index group consisted of 2 psychotics, 5 psychoneurotics, 6 personality disorders, and 2 neurological disorders. The difference between the two groups with respect to diagnosis is not statistically significant (cf. 17).

All Rorschach protocols were scored according to the Beck system. The two groups were then compared with respect to 20 of the major Rorschach scoring categories[2] by the cut-group method (3). Each group was cut at the median score of the two groups combined, and the Chi-square test was applied. None of the differences between the two groups on the Rorschach scoring categories even approaches statistical significance ($P > 0.30$ in all instances.)

These results do not confirm previous observations of relationships between Rorschach scoring categories and alpha index. Our subjects were clearly drawn from a different population from those in the other two Rorschach studies cited, so that our results are not directly comparable; but they do suggest that generalizations beyond the subject populations studied are inadvisable. This caution holds equally for the results of Saul, Davis, and Davis, as they themselves indicated.

There are limitations to the use of the Roarschach test in this manner. While clinical groups have been found to differ with respect to the usual scoring categories singly or patternwise, the latter are only part of the Rorschach data upon which clinical psychologists base their personality evaluations. Reliable correlations between single scoring categories or grouped categories on the Rorschach and specific personality variables are not well established. Therefore it must be emphasized that our results have only negative significance; they do not suggest that personality-alpha index relationships do not exist.

To our knowledge the foregoing are the only studies in which attempts have been made to relate features of the normal EEG to personality traits rather than to symptoms or syndromes. A relationship has been reported between "poor" personality and EEG abnormality, especially slow activity (5, 27). These studies are more closely related to the question of EEG abnormalities among patients with outright mental disorders than to relationships be-

[2](1) R; (2) W; (3) D; (4) Dd; (5) W%; (6) F+%; (7) M; (8) sum C; (9) P; (10) S; (11) A%; (12) number content categories; (13) sum light-determined responses, Y, V, T; (14) Y; (15) Z; (16) number subjects who rejected one or more cards; (17) experience balance, (a) M>sum C, (b) M<sum C, (c) M = sum C; (18) An responses.

tween particular features of the normal EEG and particular personality variables. An extensive discussion of the incidence and significance of EEG abnormality in psychiatric disorders will be found elsewhere (4).

In summary, in our opinion and to the best of our knowledge no study has been done conclusively showing a relationship between any feature of the normal adult EEG recorded under standard conditions and any personality trait or variable. Moreover, even if Saul, Davis and Davis's propositions were valid, neither their data nor their own conclusions warrant the unqualified acceptance of the proposition that persons with high alpha indices have fundamentally passive personalities.

Since alpha and beta activity appear to be quite primitive functions of neural tissue, we find it difficult to believe that any of their measures will be found to correlate with any of the dimensions of so complex and phylogenetically recent an entity as the human personality. If however, some such factor as a tendency of the alpha rhythm to block does prove to be related to personality, we feel, with Ostow, that it is to be explained as a concomitant of the degree of cerebral activity associated with such a personality. Magoun and his associates have shown that alpha blocking is associated with alertness and activity and have outlined how both external stimulation and cerebral cortical activity effect the blocking response (12-14, 23, 24). Such a parsimonious explanation would seem to us most tenable.

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# OBSERVATIONS ON THE TREATMENT SITUATION IN CARBON DIOXIDE THERAPY [1]

ABRAHAM FREEDMAN, M.D.

There have been conflicting reports on the efficacy of the use of carbon dioxide in the treatment of nervous disorders since Dr. Meduna published his observations in 1950 (6). Most of the investigators working in this field seem to have agreed with Dr. Meduna's hypothesis that the observed results depend upon the neurophysiologic action of carbon dioxide. Such action consists in raising the threshold of stimulation of the neurones and decreasing the feed-back of stimulation in the thalamocortical circuits, which Dr. Meduna believes responsible for anxiety reaction.

However reports of some workers intimate that there are psychic effects in the use of carbon dioxide therapy. Jackson H. Smith (12) quoted his observations on 33 patients treated with carbon dioxide. Of these 33, 21 were not helped. Four of them became so anxious that treatment had to be stopped. Three of the hysterical patients developed intense dependencies upon the treatment. The two patients who were most improved were patients who showed outward hostility and phobic reactions. Weaver, Peterson, and Anderson (13) recorded a series of 13 patients treated with carbon dioxide therapy. The patients in their series who showed improvement were the ones who had continued the treatment at their own request. A report on 15 patients by A. L. Peterson (9) noted that anxiety acts as a bar to treatment and had to be controlled by reassurance and re-education by the therapist.

Hargrove, Bennett and Steele (2) investigated carbon dioxide treatment as an adjunct to some neuroses. They recognized that there was a varied reaction to the carbon dioxide treatment and that the individual patient's reaction was in accordance with his own psychoneurosis. They concluded that carbon dioxide alone had no specific therapeutic effect. In their test group of 50 patients, one-third improved and two-thirds showed no change; 17 discontinued treatment and there were no social recoveries. Of the 50 patients in the psychotherapy group, three-fourths improved or made a social recovery, one-fourth showed no change, and 4 stopped treatment.

The discovery of an efficacious physical agent in the treatment of psychoneurotic disorders would be of unquestionable value if it were less time-consuming than psychotherapy and available to a larger number of people. However, it is not necessarily true that a physical agent works in a physical way. It is certainly true that anything done to a psychiatric patient can have a psychic as well as a physical effect.

We undertook to explore the possibilities of carbon dioxide treatment in the Psychiatric Department of the Curtis Clinic of Jefferson Hospital. Fourteen patients were treated at the Clinic. Our observations coincided with those of Drs. Hargrove and Bennett. Each patient reacted to carbon dioxide therapy according to his own psychodynamics. Several of the patients showed easily discernible evidence of transference to the therapist and the outcome of the carbon dioxide treatment depended upon the nature of the transference reaction. There was so much individual variation in the response to the treatment that it is difficult to conceive that the response depended upon anything so universal as the physiochemical reaction of neurones. For example, patient 5 was an extremely masochistic woman who had intense anxieties over the brutal treatment she was receiving from her common-law husband. To her, the carbon dioxide treatment was a sadistic act. The therapeutic effect was due to the fact that the patient was allowed to control treatment and that she did not have to fear unbridled sadism from the therapist. Also, in the course of treatment, she learned to with-

[1] From the Psychiatric Department, Jefferson Medical College Hospital; Baldwin Keyes, M.D., Professor. Psychological testing by Olive Morgan, Ph.D., and staff.

stand anxiety. It did not seem that there was any great reduction in the quantity of anxiety but there was apparently increased tolerance of her anxiety. Case 2 was a schizoid person who accepted carbon dioxide treatment and falsely claimed to have been benefitted in order to please the therapist. Refusal of treatment, despite the intense anxiety she showed, threatened her with rejection by the therapist, and this would have been intolerable to her. Case 3 had a need to be dependent and to have something done for her. The treatment answered this need, but the improvement was not sustained. Cases 8 and 9 were men with anxiety over their latent homosexuality. The treatment situation was intolerable because it became a symbolic realization of their unconscious passive fantasies.

In the following case histories, we have attempted by preliminary intensive psychiatric and psychological study of the patients to ascertain the use the patient made of carbon dioxide treatment and the way in which carbon dioxide treatment fitted into the psychodynamics. In the course of carrying out this study, we became more interested in this problem than in a simple tabulation of empirically observed results covering a large series of patients. Such tabulations may be found in other papers on the subject.

## Case Reports

*Case 1.—A. T.* This patient is a 23-year-old unmarried Negress who was first seen in Psychiatric Clinic in 1948. Before that time, she had been seen in almost every department of the Out-Patient Clinic. She had complaints referable to almost every system of the body, but aside from some pelvic inflammatory disease, there were no organic findings. There was severe overt anxiety. When seen in psychiatric interview, she would wring her hands, her handkerchief, and frequently would rub her face.

She was under psychiatric care intermittently from 1948 to 1952. At no time during this period was there ever evidence of a psychotic reaction. The history revealed that the patient came from a poverty-stricken family. She had four older brothers; one brother and her father had always made her feel unworthiness as a female, were suspicious of her sexuality, and drove her from contact with boys through her adolescence. She had rebelled against this with an adolescent love affair during which she contracted gonorrhea. After this time she gave up all interest in sexuality and it was difficult for her to discuss her sexual feeling in interviews. However, with one therapist she developed an intense supportive relationship and improved, but this was followed by negative feelings and she broke off treatment.

At the time she came into treatment she was living with her mother who was a chronic cardiac invalid. She was very much overconcerned with the state of her mother's health and felt unduly restricted by the mother's presence.

At times, psychotherapy with different therapists allayed some of the patient's anxiety and supportive relationships were maintained, but the level of anxiety remained about the same throughout 4 years of interrupted treatment.

Psychological testing in 1948 indicated a conversion hysteria with considerable guilt consciousness and some depressive features. She showed passivity as defense against her own aggressiveness. Psychological testing in 1952 showed a picture of overwhelming anxiety. Depressive trends were still present. There was some uncertainty regarding her own sexual role with some suggestion that she viewed the male role, which implied autonomy and independence, as the preferable position in life, but this created a fear of homo-sexuality.

The patient took one treatment of 5 inhalations on June 15. She was extremely anxious and pleaded that the treatment be stopped. She returned on June 22 and took 34 inhalations, again developed an extreme degree of anxiety, but seemed to develop some reassurance from the fact that the therapist in administering the treatment did not scold her and did not insist that she take any more. On June 24 she returned again but took only 10 inhalations. She said she could not take any more. On June 29, she returned for her fourth treatment and took 50 inhalations. During the treatment she was extremely anxious and did not lose consciousness. Since that time she had not been seen in the clinic but there is no evidence that her absence is due to any improvement of her symptoms. She reacted to carbon dioxide in the same way as she had previously reacted to psychotherapy; initial improvement through the satisfaction of dependency needs followed by relapse as she developed hostility to the therapist.

*Case 2.—P. K.* Patient was a 36-year-old Negress who had gone the rounds of the various clinics. She had many somatic complaints, principally gastrointestinal, and was referred to the Psychiatric Clinic in 1953. It was evident because of her extreme social withdrawal (despite the fact that she was married), her shyness and her deep-seated vague somatic complaints, that we were dealing with a pseudoneurotic schizophrenic. This was confirmed by psychological testing. Her figure drawings were classically schizoid and there was no sex identification. The Rorschach record was replete with contamination and confabulation, anatomical responses and autistic thinking. This patient improved when given supportive psychotherapy in which she was allowed to develop a dependent relationship upon the doctor, along with some symptomatic pharmaceutic therapy.

After an interval of 1 month in which she had not had any treatment, it was decided to try carbon dioxide therapy. In the first treatment, she took about 8 inhalations and became panicky, began to whimper, and treatment was stopped. She returned 2 weeks later and said that the inhalation had helped her to be healthy. She seemed to be afraid that the therapist would reject her because she had become afraid of the previous treatment. She then took 6 inhalations and became panicky. She returned 2 weeks later and said that she felt fairly well. She complained that she had felt weak and "fainty" for several days after her last carbon dioxide treatment. She consented to try it again, took 16 inhalations, began to cry, and said that she was sick. Carbon dioxide treatment was stopped and the patient again formed a supportive relationship with the therapist and has now been seen in psychotherapy every 1 or 2 months and is satisfactorily carrying out her household duties despite continuance of her somatic symptoms. Later, the patient verbalized that she had returned for the carbon dioxide treatment despite her fear of it because she was afraid that the doctor would not see her any more if she refused treatment.

*Case 3.—R. B.* This patient is a 47-year-old white widow who has visited many of the clinics of the hospital with complaints of abdominal pain, chest pain, palpitation, breathlessness, etc. Ten years previously she had had some kind of cerebral hemorrhage which was said to have paralyzed half her body, but there were no evident sequelae when she was first seen at the Jefferson Hospital Clinic in June, 1952. In her diagnostic psychiatric interview she presented a multiplicity of complaints and tried to use her complaints to gain the doctor's attention. She was demanding of time and prescriptions. She was often coquettish and seemed pleased at any evidence of special attention. Reports from clinics of other hospitals showed that a long series of organic and psychiatric treatment had not changed her condition.

She was placed on carbon dioxide treatment and received a total of 20 treatments which varied from 20 to 108 inhalations. Her attitude at the beginning of treatment was that at last something was being done to help her. She was very apprehensive with the first treatment, but became less apprehensive during the next 10. About the ninth treatment it was noted that the paient became euphoric after every treatment. At the eighteenth treatment the patient began to complain of a substernal choking feeling when breathing the gas. On the nineteenth treatment she complained of a bitter taste in her mouth and noises in her epigastrium and chest. After the twentieth treatment, she asked the doctor to stop treatment.

During the early phase of treatment, this patient showed symptomatic improvement. This improvement was related to her verbalization that "now the doctor was doing something" for her and she "always felt so wonderful after the treatment." As treatments were continued she felt that the doctor was not doing enough because he did not talk to her before and after the treatment. She then developed physical symptoms which necessitated cessation of treatment. Diagnostic studies in the Medical Clinic were repeated after the twentieth carbon dioxide treatment and they failed to disclose organic basis for the symptoms which had developed during treatment.

*Case 4.—F. K.* This patient was a 20-year-old white single woman who was referred to the Psychiatric Clinic by an industrial physician because of an anxiety state. She had palpitations, sweating, and feelings of panic when alone and was unable to continue her work as an editorial assistant in a publishing concern. Her interview material concerned her family situaton. She was the fourth of five children. Her younger brother was a veteran who had been discharged with a severe psychiatric condition and, from her description, appeared to have a psychopathic personality. An older sister was having trouble with her marriage. The patient had been to college and the family expected her to help out other members of the family who were having any kind of trouble. It was attempted to take this patient into intensive psychotherapy, but she was very ambivalent about treatment and, from the beginning of treatment, frequently cancelled appointments. She attributed these cancellations to her anxiety which would not permit her to travel to the hospital. She was first seen in the Psychiatric Clinic in February, 1952. A psychological test in May, 1952, revealed the intensive anxiety state and confusion without the syndrome of a discrete mental illness. The dynamics of anxiety hysteria and conversion hysteria were present.

Because she could not travel to the clinic regularly, she was hospitalized and carbon dioxide was administered 3 times weekly for 3 weeks. She received 20 to 60 inhalations per treatment. After each treatment she ventilated her situational difficulties and claimed that she was improving.

She left the hospital in 3 weeks considerably improved. However, she returned to the Clinic one year later with the same symptoms. She had not been employable during the interim. She remained well as long as the family considered her to be sick and permitted her to be dependent, but when pressure was put upon her to return to work, she relapsed.

The carbon dioxide treatment and the hospitalization evidently fitted her passive dependency needs and resulted in temporary symptomatic improvement, but such treatment did not restore the patient to social usefulness.

*Case 5.—R. C.* This patient was a married Italian woman in her early 40's who came to the Psychiatric Clinic because of severe anxiety, depression, and a fear of insanity. History revealed that she had always had a masochistic relationship with men which began with a brutal father, and she was currently married to a man who was both physically and mentally cruel to her. She also had much guilt

because this was her second marriage and she had been ex-communicated from the Catholic Church. Psychological testing showed feelings of intense guilt, anxiety, and a constant fear of punishment. In order to alleviate her guilt, she had become extremely masochistic. Her attitude towards other people was highly ambivalent and she established sadomasochistic relationships with most of them. Rapport with reality was impaired by intense anxiety but her awareness of her emotional difficulties was said to render her amenable to influence. This patient received a total of 50 carbon dioxide treatments given at intervals of 3 times weekly. The first 20 treatments averaged 50 inhalations each, and the number was then stepped up until she received over 100 inhalations per treatment beginning with her thirty-second treatment. In the beginning this patient was extremely apprehensive about the carbon dioxide inhalation. She complained of choking. She became afraid that the therapist would reject her or refuse further treatment to her because of her attitudes. The therapist allowed her to determine how many inhalations she would take during the first 10 treatments. After she verbalized her fear of rejection by the therapist because of her anxiety, and was permitted to express her anxiety, she began to take a greater number of inhalations and also began to show improvement in her home situation. She developed an intensely positive transference toward the therapist as evidenced by her bringing him gifts. After the number of inhalations per treatment had been increased to 80, she expressed surprise that she was able to take so much of it and said that at the beginning she did not think she would ever be able to take such a treatment. The treatment seemed to be a way of obtaining the therapist's love by submitting to his punishment. At home, she was able to achieve a more satisfactory relationship with her husband.

After the course of 50 treatments, the psychological tests were repeated. The anxiety was still apparent as was the intense feeling of guilt. The projective tests before and after treatment did not show much evidence of change.

*Case 6.—E. J.* The patient was a 21-year-old married Negress who was seen in Psychiatric Clinic because of marital discord and unbearable outward anxiety. She had married an alcoholic at the age of 16 and had four children in 4 years of married life. Her first husband had died 1 year before she came into treatment. She was offered carbon dioxide treatment. After a few inhalations she said that she could not stand it and became more anxious. The treatments were stopped and the patient did not return to the clinic.

*Case 7.—W. R.* The patient was a 21-year-old married white male who came for treatment of stuttering. He had been seen in Children's Psychiatric Clinic at the age of 14 with a history of stuttering that had not responded to 9 years of treatment in speech classes of public school. Stuttering had begun a month before starting kindergarten at age 4. At that time it was noted that when he would talk to friends and other children, or when he was angry, there was no speech impediment. The impediment first appeared when talking to adults and when using the telephone. At age 14 he was seen for a total of 10 psychiatric interviews.

He returned to the Psychiatric Clinic in February 1953. He received a total of 48 carbon dioxide treatments given at intervals of three times weekly. Treatment consisted of approximately 100 inhalations. Most of the treatments were accompanied by the physical signs of perspiration, tachycardia, increased depth and rate of respiration, and unconsciousness. After the nineteenth treatment, it was noted that his speech improved immediately after awaking. At this time he could say a few sentences without stuttering, but the impediment quickly returned. At no time in the course of treatment was any permanent improvement noted.

Psychological testing showed a superior intelligence. There was conflict between the values he placed on marriage and those which accrue from the freedom from the responsibility in the unmarried state. Hostility toward women was manifested and there were indications that this originated in his reactions to his mother. The hostility was productive of much tension to the point where it became explosive, although he was always able to control it.

During the course of carbon dioxide treatment, he developed positive, dependent transference. He would tell the therapist that the treatments were helping him although it was obvious from the way he spoke that there had been no change. When asked how he felt the treatments were helping, he would reply that the stuttering was as much, but he seemed to feel that if he kept taking the treatment he would stop stuttering. It must be emphasized that this was a subjective feeling and was not confirmed by objective observation. Since there was no improvement in the patient he was referred to a special clinic where combined psychiatric help and speech training was available.

*Case 8.—J. H.* This patient was a 51-year-old man who had been around many of the clinics of the hospital with complaints of abdominal pain. These complaints were mostly related to the upper gastrointestinal tract and studies failed to disclose organic disease. Patient had separated from his wife many years ago and now lived alone in a room. He was occasionally employed as a door-to-door salesman. He complained that when he had the pain he was unable to work.

Carbon dioxide treatment was offered but after a few inhalations the patient became panicky and said that he could not stand it. He was evidently very frightened by the treatment.

Psychological testing in this patient had shown extreme emotional immaturity. He had a contempt for the female sex and an idealization of the male sex, but was content to have fantasies of being a man. There were strong elements of latent homosexuality in his make-up.

In his case the inability to accept carbon dioxide treatment resulted from the homosexual panic which ensued when he had to lie down on a table and take something into his mouth offered by a man. At no time during his preliminary interview or psychological testing did he show the panic that he exhibited at the attempted onset of the carbon dioxide treatment.

*Case 9.—V. M.* This patient was a chronic pseudoneurotic schizophrenic who had a predominance of somatic complaints. He had been attending many of the out-patient clinics of the hospital and the Psychiatric Clinic and was asking in each case if something could be done for specific complaints. He especially wanted help for palpitation and chest pain.

Psychological testing disclosed a very passive character with a strong homosexual trend. When carbon dioxide therapy was attempted, the patient became panicky and was unable to complete the initial treatment, and did not return for further treatment. Although this patient had shown a tendency to attach himself to physicians, and was very willing to take any kind of medication that was prescribed, the situation when carbon dioxide treatment was given was too frightening to him. He did not return to the clinic after the initial treatment.

*Case 10.—W. H.* This patient was a 27-year-old male who was referred to the Psychiatric Clinic because of gradual personality change. Since his discharge from the Army, he had been unable to hold a steady job. He was unable to remain interested in any kind of studies. He would take long walks, apparently aimlessly, and on several occasions had to be returned to his home by the police. He began to require inordinate amounts of time for simple things such as dressing and eating. It was difficult for him to keep any kind of appointment on time unless he was accompanied by his mother.

The mother gave a history that this patient had been an outstanding student up to the eleventh grade in high school. He was always shy and had few girl friends. However, during his 3 years of Army service he was said to have been quite healthy and this service included 2 years overseas, more than half of which was in combat. He was always a very compliant, cooperative person.

Psychological testing showed normal intelligence. The personality was very constricted with a very restricted range of psychic reactivity. Time factor in performing the tests was exceptionally prolonged. Although he showed physiological indications of anxiety such as tremor and moist hands, there was an absence of anxiety responses on the psychological testing. The psychologists believed that organic changes had taken place in the central nervous system. There appeared to have been a maturity cessation around early teens. Because of these findings, the history was re-investigated and the mother then remembered that at the age of 5 or 6 the patient had an illness in which he had a very high fever and seemed comatose for several days. After this illness it was a week or two before he became his normal self again. The original psychiatric diagnosis in this case was obsessive reaction with depressive trends. However, the diagnosis of a postencephalitic syndrome was likely.

He received a course of 47 carbon dioxide treatments averaging around 70 inhalations per treatment. While under carbon dioxide treatment, each time, he developed a coarse tremor of the leg and arm and hands with pill-rolling movements of the fingers and resembled a case of Parkinsonism. This was never present except under carbon dioxide inhalation.

The patient expressed the feeling that he felt better after each treatment. He said that he could think and act more quickly. However, his mother reported that there were no improvements at home. In fact, she was becoming more and more impatient with him and was requesting some type of definitive treatment. The patient was hospitalized and studied for organic cerebral pathology, but none was found.

This patient reacted to carbon dioxide therapy with some anxiety and developed a rather passive reaction to the therapist. He was overly friendly and polite and tried to impress upon the therapist how valuable he felt the treatments were and how they were helping him. However, the therapist did not observe any improvement in this patient during the treatments.

*Case 11.—C. F.* This patient was a 41-year-old white female referred to Psychiatric Clinic with the complaints of weakness of the eyes, nervous prostration and exhaustion. She suffered from a chronic neurasthenia syndrome which probably masked a schizophrenic personality. She had been thoroughly studied for organic disease in other departments of the Curtis Clinic. She had a thyroidectomy performed at another hospital in 1945 for approximately the same complaints. She improved for 5 months following this operation, but the complaints then returned. There were no other organic diseases known. She had been married, but was deserted by her husband when she was 6 months pregnant. She placed the child for adoption at birth. Since then she had been on public assistance and had been very dependent upon friends. When her dependency demands become too great and she is rejected by one group, she attaches herself to someone else.

She was placed on carbon dioxide treatment once a week and received supplemental dexamyl. Up to the present she has received 36 carbon dioxide treatments averaging from 50 to 60 inhalations each. She accepts treatment as a cross she must bear and treats the therapist as someone who cannot help her but to whom she must submit. She uses the treatment to act out her ambivalent feelings of dependency and hostility to the therapist. There has been practically no change in symptomatology since treatment was started.

*Case 12.—M. C.* Patient was a 31-year-old woman who was referred to Psychiatric Clinic from the Orthopedic Clinic because of persistent complaints

of backache for which no organic pathology could be found. Psychiatric interview disclosed that the physical symptoms were screening a depressive reaction. Patient was the mother of four children and had been deserted by her husband. She had married at the age of 18, leaving a motherless home where she had been the housekeeper for her father and three older brothers. Soon after marriage the patient found that sexuality was unacceptable to her and she spoke of her husband as being beast-like and crude and complained that her four pregnancies were forced upon her. Her husband began to run around with other women and eventually left the home. The patient was embittered because he was not supporting her children properly although he was earning a good living as a contractor and was supporting his mistress in style. Although she had taken him to Municipal Court several times, she claimed that he put all the money and property in the other woman's name so that she could not touch it.

She received a course of carbon dioxide inhalations, treatment consisting of 50 to 75 inhalations. Treatments were given three times a week and she received 48 treatments. With each treatment she seemed to submit with anger. She would clench her fists, shake her head from side to side, and would fight against losing consciousness. Several times she would put her hand to her throat and claim that something was choking her and sticking in her throat. Despite her seeming aversion to treatment, she became very dependent upon the therapist and bought him a few gifts which she could ill afford.

In the course of treatment her symptoms persisted and her depression increased. After the forty-eighth treatment, she told of turning on the gas in the oven and being found by her daughter. She was, therefore, taken off carbon dioxide treatment and transferred to the hospital in-patient service where electroshock therapy was administered. The patient did not make a good recovery from her depression, but was no longer suicidal.

In her carbon dioxide treatment this patient acted as if she had a wish to be dependent upon the male therapist, but she became increasingly hostile in the actual treatment situation. It seemed as if the anger was associated with her being placed in the passive position and she unconsciously interpreted each carbon dioxide treatment as a sadistic act and a narcissistic threat. Her positive transference was evident in her attitude toward the therapist just before treatments were administered and the giving of gifts. In this very ambivalent patient the carbon dioxide treatment evidently induced the negative feelings which could not be expressed toward the object and were internalized, thereby increasing her depression.

*Case 13.—L. D.* Patient was a 35-year-old married woman who came to the Psychiatric Clinic with considerable anxiety. She had been afraid to go out on the street, and was afraid to talk to people for fear they would see how nervous she was. She wanted to leave her husband but feared she could not take care of herself because she was too nervous to earn a living. She had never experienced sexual orgasm with her husband and blamed it on him. However, she had gone out with other men and experienced the same difficulty. This had been very frightening to her because until that time she had blamed all of her sexual difficulties on her husband. She was extremely seductive toward other men, but often became angry at a sexual approach. On such occasions, when she would reject the men whom she picked up, she was sometimes subjected to beatings. She found out that she could avoid anxiety by drinking wine but became afraid of becoming an alcoholic.

Psychological testing showed signs of distortion of thinking. The ego was under severe strain and was barely able to remain intact. Depressive features also showed up on the psychological tests.

In her previous history, this patient was an adolescent behavior problem. There was much acting out and overt aggressive behavior. She was a leader in a female gang in a rough neighborhood.

The patient was placed on carbon dioxide inhalation treatments. She received an average of 100 inhalations per treatment, and received a total of 74 treatments at intervals of approximately three times a week. She began to appear for treatment wearing obviously seductive clothing and frequently sought to grasp the hand or the arm of the therapist during the treatment. On the table she would frequently lash around violently, kick her legs and arch her body resembling a "hysterie grande" seizure. Sometimes just at the end of the treatment she would laugh hysterically. During some of the treatments she would cry. By about the twenty-first treatment, however, although her reactions were similiar, she seemed to be able to control them better. After the thirty-fourth treatment, the abreactions began to increase and the control was lessened. By the time she had had 50 treatments, there was very little abreaction and the patient vocalized that she was feeling better after every treatment.

After the fifty-fifth treatment the patient broke down in hysterical crying and confessed that she had previously gone to a psychiatrist privately for 8 months. She said that she had fallen in love with him and couldn't get him out of her mind. This happened because he was kind to her, and she could not stand anyone being kind to her. She said that the same thing was repeated here and she feared that she would leave here and start the same pattern with another psychiatrist. After this confession the patient became very depressed and increasingly disturbed. She then began to express some paranoid ideas that the therapist was acting as if he knew everything she was thinking and was purposely trying to confuse her. The paranoid ideas and the disturbance increased. Instead of continuing to improve she became worse and after 74 treatments she was hospitalized and given electroshock therapy. There was some improvement with this.

Psychological testing was repeated after the sixty-sixth carbon dioxide treatment. The psychologist

noted less unreality in her ability to respond to concrete perceptual motor material as compared to the previous test. Her general motor control was improved and she had no tremor. The general personality structure did not show the amount of depression she formerly had shown. There was more free-floating anxiety. However, the psychologist believed that the increase of anxiety might have made her more approachable to psychotherapy than she was previously. The psychologist also thought that she was showing less paranoid thinking than before.

In her lifelong history, this patient had shown a propensity for sadomasochistic object relationships. She seemed to fit the carbon dioxide treatment into this pattern. Despite the fact that no formal psychotherapy was received during the course of her treatment, she developed an intense transference as she had with a previous psychiatrist under individual psychotherapy. Under this transference she showed improvement but the accompanying emotional turmoil could not be handled and she had a psychotic episode.

*Case 14.—S. K.* This patient was a 48-year-old white male who was seen on his fourth hospitalization for an exfoliative dermatitis. On previous hospitalizations a diagnosis of Hodgkin's disease had been made, but on the present hospitalization, the lymph node biopsy showed only dermatopathic lymphadenopathy. Psychiatric consultation had been requested because the patient had become depressed, listless, and withdrawn on the ward. Psychiatric history disclosed that the patient had never become reconciled to the death of his mother 12 years previously. His father died the year after the death of his mother and he had married for the first time 1 year later. Although at first he spoke of having a happy home life, he later confessed to feeling extremely guilty over sexuality despite the fact that he had fathered four children. He also felt very guilty over persistent masturbation and believed that he had permanently injured himself in this way. The dermatitis was the chief complaint and had actually started around the scrotum after a period when he felt he had too much sexual potency and had begun to masturbate after his wife refused his excessive demands. In his anxiety he would frequently finger his penis and scrotum to see whether he had injured himself, and the dermatitis began and spread from that point.

Psychological examination disclosed a primitive personality structure. There was marked intellectual poverty and childlike emotional life. There was impairment of abstract thinking. The major topic which occupied his thoughts was sexuality. There was considerable preoccupation with female genitalia.

The patient was given a course of carbon dioxide inhalation treatments three times a week. He showed practically no anxiety under the treatment and was able to stand prolonged inhalations without signs of physiological stress. At first he received 50 inhalations per treatment, but this number was rapidly advanced and at the fifth treatment he received 100 inhalations. Beginning with the fifteenth treatment, he received over 150 inhalations per treatment. He received a total of 20 treatments. During the course of carbon dioxide therapy, the exfoliative dermatitis almost completely cleared up. This occurred despite the fact that it had not responded to treatment, both internal and external, prescribed by the dermatologist, and it had not responded to X-ray irradiation. An interesting sidelight is that one of the radiologists remarked that on a previous hospitalization the dermatitis had cleared up after one X-ray treatment. This seemed so surprising to the radiologist that when the dermatitis recurred, he put the patient through the treatment without throwing any power through the X-ray tube and the skin improved as before. At the time of the present admission, however, the skin did not respond at all to X-ray therapy or placebo X-ray therapy.

The patient did not fully verbalize his feelings concerning the carbon dioxide treatment. When asked about them, he said he thought they made him feel better and he frequently asked if the treatment would help his sexual powers. When he brought up his ideas about sexuality and his feelings of guilt, he was given simple reassurance. At the end of the course of treatment, before he went home, he asked if it was all right to have sexual intercourse with his wife. This permission was granted. The patient was seen for a follow-up visit about 3 months after treatment. His sexuality was no longer bothering him and his skin had remained clear. Psychological retesting after the course of treatment showed no change in the patient's personality makeup as disclosed by projective tests. However, the psychologist remarked that the patient seemed to be much more alert and more energetic than he had been although he had the same difficulty in comprehending and following instructions.

## Summary

Fourteen patients were treated according to the method of Meduna with inhalations of a gas mixture containing 30 per cent carbon dioxide and 70 per cent oxygen. The results were as follows: One patient was markedly improved and sustained the improvement; one patient improved and sustained the improvement; two patients temporarily improved and then relapsed; two patients developed psychotic reactions and had to receive electroshock therapy; one patient (a stammerer) claimed to have improvement but there was no supportive evidence of change; two patients showed no improvement; five patients stopped treatment.

## Comment

The reactions of each individual patient to carbon dioxide treatment followed their transference reactions to the therapist administer-

ing the treatment. In this small series of cases, some common reaction patterns were evidenced. Patients with masochism and depression accepted the carbon dioxide therapy as punishment and responded with symptomatic improvement at first, but if they developed ambivalent feelings toward the therapist which could not be expressed, depression was intensified. A patient who obtained masochistic gratification out of the treatment without the fear of losing control of her masochism showed improvement. Patients with unrecognized latent homosexual conflict could not accept the treatment situation. Patients with a large quantity of free-floating anxiety could not stand the increased anxiety induced by the treatment. Patients with strong dependent needs felt they had to accept the treatment in order to retain the protection of the therapist.

Another possibility of the mechanism of action of carbon dioxide treatment can be assumed. Carbon dioxide is a basic biological stimulus for anxiety. The sensation of asphyxiation may well be one of the earliest precursors of the anxiety reaction. The patient taking carbon dioxide inhalations experiences the anxiety of asphyxiation under the protection of the therapist and may thereby become conditioned to withstand anxiety.

Another phenomenon observed was the intensity of the transference reactions which developed upon relatively brief contact. Since carbon dioxide impairs the function of cortical cells, its action might be translated in analytical terms as that of impairing the secondary processes and thereby reducing the control over the primary processes. Since the phenomenon of transference depends upon activity of the primary processes, increased transference reactions could be expected. Our observations indicate that the observed results of carbon dioxide treatment can be explained on a psychological basis rather than on a physiologic basis.

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1601 WALNUT STREET
PHILADELPHIA 2, PA.

# PSYCHIATRIC DIAGNOSIS, ITS NATURE AND FUNCTION[1]

E. L. CAVENY, CAPT., MC, USN, C. L. WITTSON, COMMANDER, MC, USNR, W. A. HUNT, COMMANDER, MSC, USNR, AND R. S. HERRMAN, LT. COMMANDER, MSC, USN

In the course of an extensive investigation of the efficiency of neuropsychiatric selection and its application to the important problems of military manpower, the authors have become increasingly interested in the basic techniques or tools such as the psychiatric interview and the process of diagnosis by which selection accomplishes its purpose. Psychiatry pays relatively little attention to these instruments *per se*, and concerns itself currently largely with the broader issues of general personality, structure, psycho-biological development, and their theoretical integration into systems of therapy. Yet the understanding and successful use of such basic techniques as diagnosis is essential to the practice of psychiatry in all its many aspects. The act of classification, based upon accurate description and implying the possibility of prediction for the future, is basic to all science; nevertheless, in its psychiatric guise as "diagnosis" it is the subject either of relative neglect or of much unjustified criticism springing from a misunderstanding of its true nature and function.

The reasons for this relative neglect stem in large part from the fact that current psychiatry with its overwhelming preoccupation with the practical problem of altering pathological behavior is essentially an applied science rather than a pure science. The distinction between the mere acquisition of knowledge and understanding as "pure" science, and the practical application of that knowledge to the affairs of men as "applied" science is of course somewhat artificial and subject to the dangers of all generalizations. Nevertheless, some distinction is possible. There are differences in motivation, in goals, in rewards, and in the concomitant working pressures and attendant emotional tensions; and these differences give rise to differences in the problems stressed, and in the work habits with which they are approached. The applied scientists concentrates on practical results. The end occupies his attention, and justifies the means. He is more interested in arriving, and has relatively little curiosity for how he got there. He borrows techniques, asssumes their infallibility if they get results and, if pressed, tends to create elaborate intellectual and emotional rationalizations to justify them rather than subjecting them to careful experimental investigation. He acts, and gets the practical business of the world done.

The pure scientist is less interested in practical results. Often he is less interested in the end, and more concerned with an elaborate analysis of the means by which he achieved it. He creates techniques, challenges and evaluates them, forever questions them. He doubts, hesitates, and pauses. He insists on taking time to understand and comprehend. If he does accomplish some practical social aim, he is more apt to be embarrassed and surprised than proud.

Such differences are of course mass generalizations. Within any discipline, or in any one scientist, the picture is mixed and confused. Yet these differences exist and cause their own special problems in any particular field. To understand contemporary psychiatry we must face the fact that it is basically an applied discipline and interested primarily in the accomplishment of immediate, practical ends. Herein lies its current preoccupation with therapy and its relatively complete absorption in the practical goals of altered patient behavior. If this is accomplished in the desired way, success is assumed, and little careful analysis is given to the means by which it was

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attained. Psychiatry often fails to understand the complexities and demands of accurate scientific observation and objective reporting, has little time to question and analyze its techniques, accepts apparent heuristic value as substitute for genuine validation, and tends to concern itself both theoretically and experimentally only with matters of immediate and pragmatic concern to the therapeutic situation. It is significant that Redlich's (1) interest in the problem of recording and evidence in the psychiatric interview with his stress on the difference between primary data and inference, and Kubie's (3) interest in the problems of experimental design in studying the unconscious, both common types of effort in the "purer" sciences, are relatively unusual in psychiatry.

As it has with so many other of its techniques, psychiatry has tended to accept diagnosis on a superficial, heuristic basis, or to reject it in the same way, without bothering to understand its essential nature, to analyze its basic function, and to comprehend its full potentialities. The basic technique of diagnosis itself often is identified with some specific diagnostic system, and the general process evaluated in the light of some particular application, often mistaken or misused. It is as though the entire principle of psychotherapy were to be accepted or rejected on the evidence provided by some particular technique such as psychoanalysis.

Diagnosis is essentially the old familiar scientific process of classification, of introducing order into one's observations with an attendant increase in meaningfulness. It serves the same purpose as taxonomy in biology and, if one does not object to a somewhat tangential circumlocution, one might refer to diagnosis as the practice of taxonomic categorization. It is the labeling of an object or phenomenon in order to indicate its inclusion in a class of similar objects. Essentially it is a labor-saving device, a short-cutting process much like Hollingworth's old priniciple of redintegration, wherein the stress was placed on the ability of the partial clue to reinstate the entire phenomenon. By placing the object in a certain class, it is possible to infer on the basis of this class membership the possession of certain common class characteristics by the object without the necessity of further experience of it. Diagnoses are carriers of information, and they should be viewed as such. They should be evaluated in terms of the economy with which they transmit information, the extent and accuracy of the information transmitted, and the functional importance or relevance of this information in the particular diagnostic situation. These are the parameters on which the value of any dignostic system must be plotted.

Diagnosis involves the gathering of observations, an act of judgment whereby the object observed is placed in a category or class, and then the drawing of permissible inferences. While taxonomy in biology stresses information, understanding, the comprehension of the present and historical aspects of the phenomenon and its relation to other phenomena, diagnosis in psychiatry tends to stress the prediction of future developments, the anticipation of later symtomatology to be expected, the future course of behavior, and the possibility of and means for its control. In psychiatry this predictive aspect is dominant, and it necessarily colors both the use and development of diagnostic categories. It leads to an underestimation of diagnosis when the stress is on the "understanding" of the patient, and an overestimation (at times almost a blind imputing of magical powers) when the stress is on the anticipation of future behavior or the administrative rationalization of custodial controls.

Diagnosis is not tied to any one set of categories. It is not the private and special technique of Kraepelinian or of neo-Kraepelinian psychiatry. The tendency to identify diagnosis with Kraepelin is unfortunate, as is the current practice of either vilifying Kraepelin outright as a systematist or of blindly glorifying him as a genius of descriptive psychiatry. One should approach the Kraepelinian system neither to bury nor to praise it, but rather in the role of coroner to assess whether or not life remains in it, and if so to decide whether the energy level is sufficiently high to meet the demands of current clinical practice. Diagnosis can be psychoanalytic, Freudian, Jungian, or Adlerian; it can be organically oriented; it can be functionally oriented; or it can be eclectic. A diagnosis can be conveyed by a single term or by a phrase. Thus the term "anal erotic," the phrase "unresolved Oedipal com-

plex," or the sentence, "He shows evidences of oral aggression," are as much diagnoses as are the words "dementia praecox" or "manic-depressive." The essence of diagnosis lies in the location of an individual (patient if you will) in relation to a known class of other individuals with the attendant possibility of prediction beyond the limits of one's historical knowledge of the individual himself. Type theories, trait theories all imply diagnosis, and their classificatory categories are diagnostic. Even the simple statement "the barometer is falling" is a diagnosis with prediction inherent in it.

Diagnosis is not tied to any Aristotelian concept of identity. It does not entail entelechy, nor teleology. It is simply the use of classification to communicate information as a basis for action. If ideas of "entelechy," or mystic conceptions of "disease," are present in its use, it is because these ideas are present in the minds of the men who use it. The information conveyed by diagnosis will always be distorted by the perceptual biases and limitations of the professional individuals practicing it. In any age classificatory categories will be interpreted and elaborated in the context of the level of knowledge, the cultural milieu, even the needs and desires of the group using them, but such interpretations are not of necessity inherent in the diagnostic process itself. Entelechy may have been implied by Kraepelin, a rigid concept of disease may have existed in his mind (and certainly these things were also present in the minds of his audience), but his system of classification exists apart from these implications as a simple descriptive system based upon behavioral observations. Would that we spent more time checking the accuracy of his observations, the reasonableness of his groupings, and the predictive value of his categories, and less time in quasi-philosophical attacks upon the theoretical implications of his system, which are after all secondary to the descriptive task he was attempting.

Diagnostic systems are flexible, and changeable. They alter as knowledge develops. It would be a sad reflection on the scientific labors of psychiatry if the Kraepelian categories were not today in need of modification. It is a sad reflection upon psychiatry that they have not as yet gotten it in any satisfactory fashion. Moreover, diagnosis is a tool of communicatory convenience and its terms will always reflect the contemporary demands upon the diagnostician. "Deterioration" may become "regression," but these fashionable reflections of our current culture should not distract us from the underlying behavior they point to. Diagnostic systems will come and go; they may coexist in infinite variety; they may refer to different aspects of behavior; and they may spring from different levels of observation. If they serve their purpose of communicating relatively adequate information making possible reasonably accurate predictions in apparently important social situations, they will have been of use to us.

The specific functions of diagnosis are infinite, but we shall discuss them under four headings—administrative, therapeutic, research, and preventive. The first function to be discussed is the *administrative* one. This refers to the well known legal uses of diagnosis such as the determination of "insanity" as a defense in court, declarations of incompetence, involuntary commitment, etc. It also refers to institutional diagnosis for commitment, as a basis for selecting the type of ward suited for custodial care, and for purposes of official record. It refers to clinic diagnosis as a basis for acceptance or rejection for therapy, or for indicating preferred therapy or therapist. It refers to diagnosis for all the busy paper work that accompanies the official side of social living. Sometimes it appears ridiculous, as when a staff diagnosis achieved after an hour of learned wrangling is entered in an official record and the patient then forgotten, but usually these practices spring from sensible social demands. Thus the staff diagnosis assigned in a custodial institution where lack of staff and overcrowding renders any therapeutic endeavor impossible may seem futile. Suppose, however, realizing the importance of custodial commitment to the individual committed, one wished to assure some review of the case before the action became final. Is there any better way than to require a staff diagnosis at the receiving custodial institution?

In addition, such administrative diagnoses serve as a permanent record of the ebb and flow of the mental disorders. They furnish the material for the census figures upon which the

Public Health Service bases its understanding of the past and its preventive action for the future. Without them the military services would be unable to cope with the psychiatric aspects of their manpower problems, unable to plot the psychiatric needs of today and to anticipate those of tomorrow. Without them a large part of current psychiatric research would be impossible. They are much more vital and important to psychiatry than their humble origin and nature might indicate.

A further military illustration of the administrative use of diagnosis may be given. During World War II the medical department of the Navy established a diagnosis known as "No Disease: Temperamental Unsuitability." This was reason for discharge from the service. On the surface it may seem paradoxical for a medical category of disability to be placed under the heading of "no disease," but there was good reason. At the time some 3 to 5 per cent of Naval personnel were functionally ineffective. Their presence in uniform was contributing nothing to the military effort. It was a rag-tag population consisting of the poorly motivated, the physically and intellectually inadequate, the uneducated, etc. It was the inevitable consequence of a manpower policy that stressed mere numbers rather than capability for service. These men, however, were not psychiatric cases. They were neither marginally psychotic nor neurotic, nor were they mild behavior disorders. They were just unusable, simply not worth their military salt.

The Navy had an administrative channel for disposing of such people. It was an administrative discharge, given by line personnel, and adopted for such a contingency. It could not be used, however, because of public relations. With so many men in uniform, the public resented any exemptions from service. It is classic to our culture, however, that the sick are exempted from the demands put on the well. Thus the public would accept a medical discharge where it rejected a purely administrative one, and to the medical department fell the task of draining off this vast reservoir of unsuitable individuals through the diagnostic channel, "No Disease: Temperamental Unsuitability."

Superficially this might appear both improper and unwise, but it was socially reasonable and necessary. As an heuristic procedure it served a temporary purpose, and when it was no longer needed its inherent difficulties and deficiencies resulted in its abandonment. The same is true of many other administrative diagnostic functions which appear unreasonable or even ridiculous until they are viewed in the total social context. Before administrative diagnosis (and that much maligned field, administrative psychiatry) are condemned off-hand, a careful examination of the circumstances is in order.

The *therapeutic* functions of diagnosis are well known. Diagnostic categories to be of maximal clinical aid should carry therapeutic implications. Unfortunately they often convey little in terms of indicated therapy. The blame rests not on diagnosis *per se,* but on our relative ignorance of etiology on the one hand and of what actually transpires in therapy on the other. We are somewhat dubious about what we are doing in the therapeutic situation, and equally dubious about just what we are doing it to. Under the circumstances, developing a clear and meaningful classificatory system is a bit like catching the proverbial black cat in the proverbial darkened room.

A little more attention to descriptive psychiatry would be appropriate under the circumstances. Hallucination, delusion, stereotypy, stylized behavior, etc., all the phenomena through which patients manifest their difficulties, might well become material for intensive study. As it is, contemporary psychiatry tends to accept them rather in the nature of given absolutes upon which a system may be based, as pawns in some theoretical chess game, without assuming that some study of the pieces involved might shed light on the nature and rules of the game.

Actually we might try shifting the frame of reference, abandoning dubious etiology and classifying under effective treatment (if we can agree there is such). We might have the shock sensitive disorders, subclassified as to electric, insulin, or convulsive, those sensitive to the various types of surgical interference, and those sensitive to psychotherapy. Perhaps psychotherapy is too vague and inclusive a term for the purpose. Is the effective agent catharsis, transference, insight, relearning, socialization, or what weighted combination of these? Until

these questions are answered, until we have more data on exactly what is transpiring in psychotherapy, we may well have to mark time in the development of diagnostic categories with efficient therapeutic reference.

Perhaps we might abandon the concept of cure in the radical sense that it sometimes is used in medicine and surgery, and accept instead the criterion of amelioration; for there is more evidence that patients get better, than evidence that they get well. We might then classify under other therapeutic rubrics such as sedation, support, and environmental manipulation, the first and last of these among the most potent but the least talked about techniques in the therapeutic armamentarium.

The value of such regrouping would not only lie in a clarification of our therapeutic aims, but it might produce strange bedfellows, and the necessary apologia of this disturbingly intimate relationship might reveal new aspects of and approaches to our problem. There is reason for every sympathy with current organic and functional therapies, but if one turns from the sheltered, self-manipulated stage of private practice to a contemplation of the institutional, custodial scene, to the broad problems of state and national mental health and of military welfare, one cannot help but conclude that the word progress is suitable only in a very relative sense.

This last suggestion, that regrouping under new diagnostic categories might restimulate our thinking, brings up the next function of diagnosis—*research*. Classification is not a static process, but a continuing one. One groups, sees new relationships, then regroups. Let us take one example. Lorr and Jenkins and their colleagues in the V.A. are making great use of factor analysis, a mathematical version of diagnosis (4). Recently we have been privileged to see unpublished material by Lorr, Jenkins, and Holsopple demonstrating three major factors in chronic schizophrenia. One is a withdrawal factor with concomitant motor disturbance, one a factor of distortion in preception and thinking, and one a fighting reaction (typical of paranoids). Recently Thorne has stressed the evidence in animals and man of a well established anger reaction, and suggests that acute and chronic anger states may constitute a primary syndrome of personality disorder, with paranoia being a symptomatic expression of an underlying anger state (6). If we combine the empirico-theoretical conclusions of Thorne with the experimental data of Lorr et al we get a suggestion that paranoia might be approached as a chronic, habitual anger response superposed upon a basic schizophrenic process. The illustration may be poor, but the point is clear.

The final function of diagnosis is often overlooked. It is a *preventive* function. Diagnosis is a means of case finding, of identification of individuals either for the treatment of current pathosis or the prevention of future pathosis. As neuropsychiatric selection, or screening, it constitutes an important aspect of military psychiatry. An example is the psychiatric screening to which the Navy subjects each new recruit upon his arrival at a Naval Training Center. The separation of the "sick" from the "well" in order that the former may be released from service before they suffer further damage, is but a minor purpose of this psychiatric scrutiny. Most important is the identification of those borderline individuals whose marginal adjustment needs reinforcement if they are to adjust to military service. Only after they are located, however, can they be aided. Immediate diagnosis is necessary for prompt preventive treatment.

Such preventive diagnosis also occurs in court clinics, college health programs, etc. Recently the U. S. Public Health Service has become interested in including some case finding procedure in their community health survey programs. Psychiatric diagnosis may well become as common a part of the preventive medicine of the future, as is the chest x-ray today.

These various functions make varying demands upon diagnostic systems. They may even conflict. Certainly they are a source of confusion in the current diagnostic scene. Only if these disparate functions are clearly understood, accepted each in its own right, and each given its just due can we begin to restore order to apparent chaos.

It is remarkable that with all the general criticism that has been leveled against diagnosis there have been few concrete proposals for its systematic evaluation and improvement. Information theory promises this, and is ideally fitted for the task as we have suggested above,

but the job still remains to be done. Help may come from the experience of workers in other fields. This problem of diagnostic classification is one that has disturbed the psychologists engaged in counseling and guidance. Their problems are not those of psychiatry, their categories not those of mental illness, but they have the same need for generalized concepts to aid them in identifying particular problems and to help them in finding solutions to these problems. Pepinsky (5) has proposed six categories for classifying the problems encountered in guidance and counseling. These categories are lack of assurance, lack of information, lack of skill, dependence, self-conflict, and choice anxiety. The categories themselves are of no help to psychiatry. They spring from different problems and a different context. Pepinsky, however, has gone further and has put his category system to an experimental proof using five criteria for its evaluation, and the five criteria he proposes *are* applicable to psychiatric problems. They offer an excellent framework for the evaluation of any clinical diagnostic system.

The five criteria proposed by Pepinsky state that "good" diagnostic categories should: "identify the causes of maladjustment, be as inclusive as possible, lead to consistent and accurate diagnosis, possess relatively unique and distinctive characteristics, and indicate distinctive and adequate therapy. In essence, this is what we ask of any system of psychiatric diagnosis.

The middle three are logical demands, applicable to any system of classification. The more inclusive a category or set of categories, the more widely applicable or "useful" it will be. Yet it must not be so wide that it includes everything. To be useful it must point to a distinct and distinguishable class. We probably cannot hope for all-or-none characteristics in our categories, but at least we can achieve quantitative differentiation of the class characteristics. Consistency and accuracy are our old friends reliability and validity. These criteria are ideally suited for evaluation by information theory.

The first and the last criteria are more functional. A category should identify etiology and indicate preferred therapy. These are less abstract, apply to the needs of special classificatory fields, are definitely felt wants for psychiatric categories, and are at present much more difficult to satisfy. Much more research on etiology and on therapy will be necessary, however, before they can be applied to psychiatric diagnoses with any success. Meanwhile their consideration in relation to our currently employed categories should produce a prophylactic scepticism and a genuine dissatisfaction which might serve as a motivation to further research.

We have conducted a defense as well as a discussion of diagnosis. Diagnosis as a process, as a basic scientific classificatory technique, is a necessary instrument in psychiatry. Its functions may be misunderstood and it may be misused, its class categories may be faulty, and even good categories may be mistakenly applied. Such errors have been discussed elsewhere in connection with military psychiatry in World War II (2). But these are crimes of human commission and not attributable to the instrument itself. Like mathematics, diagnosis is susceptible to the deliberate distortions of liars and to the unwitting distortions of fools. Diagnosis itself remains guiltless.

In defending diagnosis, we have had a larger cause in mind. We have chided psychiatry for the casual neglect it exercises toward many of its tools, while it concerns itself almost exclusively with vast theoretical matters of personality structure, psychotherapy, and even the ethereal realms of cosmology. It is a mark of maturity and development in a science when it can pause to assess, to analyze, to challenge its techniques and instruments as such. When psychiatry can stop to investigate and attempt to understand the procedural foundations upon which its knowledge is based, it will scientifically be coming of age. As it is, we have discussed diagnosis.

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# RELATIONSHIP OF SEXUAL PSYCHOPATHY TO PSYCHOMOTOR EPILEPSY AND ITS VARIANTS[1]

GEORGE N. THOMPSON, M.D.

The subject of sexual psychopathy is one that in recent years has aroused intense interest, and it is one that all who must deal with psychiatric problems are called upon to meet. We are frequently asked to give advice concerning psychopaths and perhaps to treat them or to attempt to treat them. If one looks through the literature or talks to groups who represent various points of view in psychiatry, one finds that they are as divergent as it is possible to be, not only with regard to what sexual psychopathy is but with regard to its cause and treatment. Often one even finds it difficult to define sexual psychopathy, and most of us are finally forced to that most unfortunate position of having to refer to law books and to apply the legal definition. The subject has aroused sharp emphasis recently and has exposed the tendency of psychiatry to discard diagnosis. In recent years we have noted that many of our students are not making diagnoses but are simply describing patients, so that we no longer hear the term psychopathic personality but we hear, for example, about the aggressive reactions or the passivity of the psychopathic individual. It is to be noted further that many psychiatrists think there is no such thing as a psychopathic personality.

At this point it would perhaps be well to clarify the usage of the terms "psychopath" and "psychopathic personality." By the narrow definition of psychopathic personality is meant the primary deep-seated character defect, a defect that is based primarily on the lack of ability to develop an adequate concept of time in relation to self. Individuals with this disorder have no ability to do long-range planning or thinking. They are unable to plan for the future. This character defect is apparently the basis of all the secondary symptoms that we see. The principal secondary symptoms that these patients have are lack of discretion, lack of judgment, and certainly a marked diminution in wisdom. They are impulsive; their behavior is almost classically so. Furthermore they demonstrate an inability to profit from experience. They have also a peculiar ability to ingratiate themselves with others, so that they are able to play upon the good graces of courts, parole committees, ministers, and physicians and to obtain parole from prison. They are even able to secure the favor of state hospital superintendents and to secure release from state hospitals—all through this remarkable, unusual ability to ingratiate themselves. Among other peculiar characteristics they have also the characteristic ability to justify the end to be attained. The true psychopath, by whatever name he is called, will always justify what he does, and he will feel justified in his own mind.

The foregoing are principal or basic characteristics of the person with psychopathy. Superimposed on these traits are the various types or ramifications of sexual disorders.

Dr. London (1) first described some cases under the title of "paraphiliac neurosis," but this writer would like to eliminate them from the present discussion. When a patient seems to be a psychopathic personality of pathological sexuality subtype, that patient may assume the guise and not have the blight. That patient may in fact be a person with a psychoneurosis, since one form of psychoneurosis evidences symptoms not unlike those of pathological sexuality. Because of his psychoneurosis the individual is compelled to abnormal sexual behavior. The distinction between psychopathic personality, pathological sexuality, and its neurotic counterpart of paraphiliac neurosis is quite simple; that is, it usually is simple. We merely determine whether the basic characteristics of psychoneurosis are present. There of course are many borderline cases, there are cases that are puzzling, there are cases that take months in order to clarify.

There is another term that has been used in

[1] Read before the annual meeting of the American Neurological Association in Atlantic City on May 8, 1952.

medical literature and which, in fact, was stressed by a local colleague and friend, the late Dr. Otto Fenichel (2) who, however, was not the first to use the term. The designation of character disorder was employed for many of these patients. To this writer the term character disorder seems applicable in certain cases but not for the true cases of sexual psychopathy, for there is a distinct and marked difference. Some people have only character disorders, but they are not the sexual psychopaths.

The cause of sexual psychopathy or, for that matter, of any form of psychopathic personality is still unknown. Yet our knowledge of probable or possible causes is not inconsiderable.

Psychopathology has contributed much to our knowledge of sexual psychopathy, but it leaves much unanswered. There are a few cases that, interestingly enough, seem to occur following cerebral trauma. These are cases well studied clinically of patients who live normal sexual lives up until the time that they receive severe cerebral trauma and then become sexual psychopaths. The relationship to cerebral trauma of the psychopathy in these patients is very difficult to determine. Those patients who have developed sexual psychopathy following cerebral trauma have been most interesting and have contributed much to our knowledge. The work of Karl Kleist in Germany and the work of several people in this country has contributed much to our knowledge of certain neuronal patterns that may underlie psychopathy, whether it be sexual psychopathy or psychopathy of other type. A number of workers have traced, or at least have emphasized, the importance of the orbital convolutions of the frontal cortex and of the connections of these with the cingulate gyri and the connections of the cingulum to the diencephalon. The cingulate gyrus has received considerable attention just recently in relation to personality; and whether or not one believes that the brain has anything to do with personality, some of these cases based on cerebral trauma are most convincing.

The course of sexual phychopathy is well known. True sexual psychopathy is unyielding and unresponsive to treatment. Seemingly the therapeutic regimes to be applied are either those of a custodial hospital where the patient cannot leave or a prison; the dilemma frequently—which? Hospital or prison? Usually the hospital staff thinks that the patient should be in prison, the prison people think that he belongs in a hospital, and the physician who works with some of these patients can sympathize with both hospital and prison personnel.

The treatment for sexual psychopathy is another profound dilemma since there is no treatment that is truly satisfactory. Medical treatment is of no avail. There is no shock treatment that is of any value in the treatment of sexual psychopathy. Sexual psychopaths have been treated with convulsive shock therapy to the point of extinction of their memories, and when their memories did return, they were interested primarily in the resumption of the psychopathic sexual activity (5). Insulin shock treatment is of no help in these cases, but neurosurgery seems to offer some promise for the future. A few patients have been operated upon, selective ablations of the cortex of the brain having been done. In a few cases some severance of connections of the cortex with the thalamus or operations upon the thalamus have been done with seemingly some improvement. But it is much too early to evaluate these cases. We know of only a few cases, and so far it has been simply a matter of grasping at straws. Since medicine and particularly psychiatry has not solved the therapeutic aspects of this problem, it is hoped that perhaps the neurosurgeon will come to the rescue.

There is a most interesting association of some cases of sexual psychopathy with psychomotor epilepsy, and there is also an interesting association of these cases with those of patients who have been clinically diagnosed as suffering from pathological alcoholic intoxication. As a matter of fact, it seems to this writer that pathological alcoholic intoxication and psychomotor epilepsy are the same disease under two different names. In the one case psychomotor attacks simply occur spontaneously; in the other, psychomotor attacks occur under the influence of alcohol. A number of patients with sexual psychopathy behave as if they had psychomotor attacks. There have, as a matter of fact, been patients who have engaged in extremely bizarre psychopathic be-

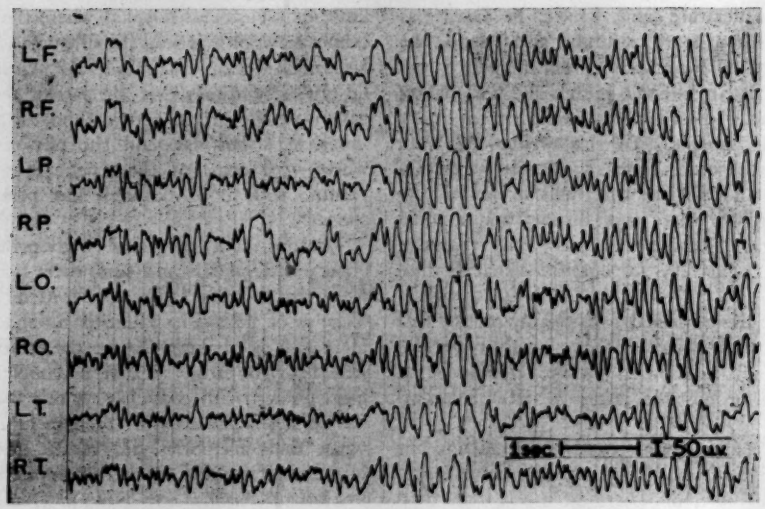


*Fig. 1.* This electroencephalogram of a patient with clinically psychopathic behavior shows a psychomotor-seizure discharge. The 6-per-second activity is the most frequently found psychomotor wave pattern.

havior and later had no recollection of it; these patients are so similar to cases of psychomotor epilepsy that there is essentially no differentiation. However, it is only some cases of sexual psychopathy that fit this pattern.

Illustrations are presented which seem to demonstrate an interesting relationship between sexual psychopathy, psychopathic personality, pathological intoxication, and psychomotor epilepsy. These were selected cases of psychopaths who had psychomotor epilepsy and episodes of pathological intoxication. The first illustration (fig. 1) shows a psychomotor-seizure discharge occurring in a patient with clinically psychopathic behavior. The 6-per-second activity is the most frequently found

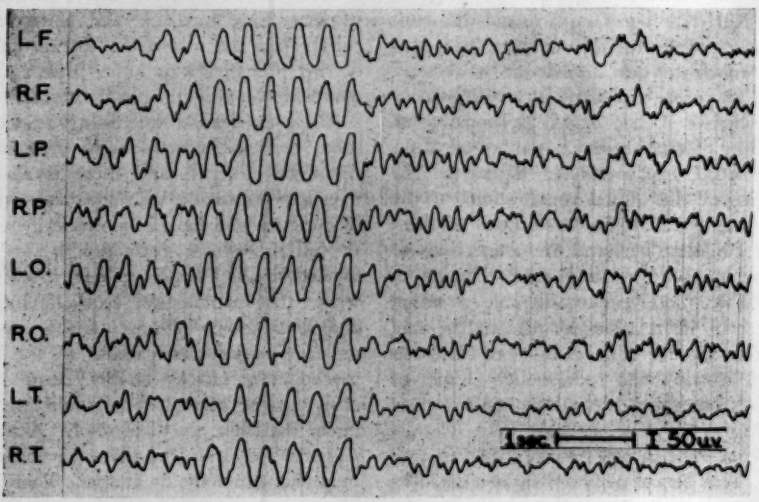


*Fig. 2.* Electroencephalogram of patient who showed clinical psychomotor-seizure discharge of about 3-per-second activity.

psychomotor wave pattern. In the next case, clinically the patient showed psychomotor-seizure discharge of about 3-per-second activity (fig. 2). This correlative electroencephalographic evidence shows a relationship between psychopathic personality, pathological intoxication, and psychomotor epilepsy. The three disorders are apparently variations of the same fundamental cerebral disturbance and may in fact be identical.

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# IDIOPATHIC PERIPHERAL FACIAL PARALYSIS (BELL'S PALSY) [1]

ERWIN M. JACOBS, LT, MC, USNR, AND HENRY S. COLONY, CDR, MC, USN

Anatomical and clinical studies of the fifth and seventh cranial nerves were published by Sir Charles Bell in 1821. In his discussion of the facial nerve he mentioned (2), "It is very frequent for young people to have what is called the blight; by which is meant, a slight palsy of the muscles on one side of the face, and which the physician knows is not formidable." Formidable indeed are some of the treatments, however, which are advocated for peripheral facial paralysis, commonly known as Bell's palsy (1, 5, 7).

The prominent symptom of a peripheral facial paralysis is an ipsilateral palsy of the muscles of facial expression, including the frontalis and orbicularis oculi muscles. Taste may be lost over the anterior two-thirds of the tongue and hyperaccusis may occur if the lesion is proximal to the chorda tympani nerve and the nerve to the stapedius muscle. Changes in hidrosis of the face, tearing and salivation may occur. There is no sensory loss or change in the corneal reflex, although this may seem to result because of inability to close the eye (15).

Within the last four years, 44 patients with idiopathic peripheral facial paralysis were admitted to this hospital. All were Naval personnel on active duty except one who had been retired and one female dependent. There were two females in all, and only one Negro. The average age was 26 years; but the distribution was as shown in table 1. The seasonal incidence of idiopathic peripheral facial paralysis has been of interest because blasts of cold air often have been considered a causative agent. If this were true more cases would occur in the winter months, but this has not been substantiated in the present study (table 2). Only six patients had a definite history of exposure to drafts.

Nine patients had complaints of aching about the ear and one had discomfort about the eye on the side of the lesion. Twelve patients stated that their faces were "numb" although no sensory loss was found. The right side was paralyzed in 26 cases and the left side in 18. Changes in taste were present in 23 patients but hyperaccusis was not recorded routinely. A facial paralysis had been present previously in only two instances (4.5 per cent). The average duration of the paralysis was 49 days but half of the patients had re-

TABLE 1.—AGE GROUPS (AGE IN DECADES AND NUMBER OF PATIENTS)

| | | | |
|---|---|---|---|
| First | 0 | Fourth | 9 |
| Second | 9 | Fifth | 2 |
| Third | 24 | Sixth | 0 |

TABLE 2.—SEASONAL INCIDENCE (MONTH OF ONSET AND NUMBER OF PATIENTS)

| | | | |
|---|---|---|---|
| January | 2 | July | 1 |
| February | 6 | August | 2 |
| March | 5 | September | 3 |
| April | 5 | October | 3 |
| May | 3 | November | 4 |
| June | 9 | December | 1 |

TABLE 3.—DURATION OF PARALYSIS

| No. of Weeks | No. of Patients |
|---|---|
| 0-2 | 6 |
| 2-4 | 16 |
| 4-6 | 7 |
| 6-8 | 3 |
| 8-10 | 1 |
| 10-12 | 3 |
| 12-14 | 1 |
| 14-28 | 7 |

[1] From the Neurology and Electroencephalography Branch, Neuropsychiatric Service, U. S. Naval Hospital, Oakland, California.

The opinions expressed herein are the personal ones of the authors and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

covered in four weeks, regardless of the therapy received (table 3). In the cases where taste was lost or impaired, the mean recovery time was 47 days.

A complete blood count, urinalysis, and serologic reactions of the blood were normal in all of the cases. Lumbar punctures were performed on 22 patients and showed normal manometrics, cell counts and serologic reactions of the spinal fluid. The average total protein was 28.8 mg. per cent and none was beyond the normal range. Roentgenograms of the skull, with special views of the mastoid and petrous portions of the temporal bones, were normal in the 40 patients x-rayed. Electromyograms were done in 10 instances but were of little prognostic value.

Nine of the patients in this series received no treatments or drugs and the average recovery rate was 19.5 days (range: 9-33 days). Physiotherapy in the form of heat, massage and electrical stimulation was used in 14 cases in which the mean recovery time was 44 days (range: 10-130 days). In addition to physiotherapy, vitamins such as thiamin, ascorbic acid, nicotinic acid, B-complex and multivitamins were administered orally and intramuscularly to five patients. This resulted in an average recovery time of 55.6 days (range: 18-117 days). BAL, added to the vitamins and physiotherapy in 10 cases, produced a mean recovery time of 51.1 days (range: 9-161 days). Cortisone was given to six patients, in addition to the vitamins and physiotherapy; three received the drug at the onset of the disease and three after the palsy had been present for various periods. The average duration of paralysis after the cortisone had been administered was 47 days (range: 25-76 days).

## Comment

Although the use of the term, "Bell's palsy," has been widespread for many years, it fails to describe adequately any definite clinical entity. A peripheral facial paralysis may be due to a variety of demonstrable lesions along the course of the seventh nerve and may be accompanied by taste loss, hyperaccusis, tearing, and changes in hidrosis of the affected side. It is felt that idiopathic peripheral facial paralysis is a more accurate nomenclature which may be modified by terms such as partial or complete, in addition to mentioning other symptoms.

When the etiology of a peripheral facial paralysis cannot be determined, an attempt is made frequently to seek evidence of exposure to drafts. There has been no confirmation of this theory (9, 15). A low-grade infection of the facial canal has been cited as a cause for early radical surgery, but none of the findings of this series would seem to warrant such extreme measures (1, 4, 5, 7). The most logical explanation is that swelling, not due to infection, results in ischemia of the facial nerve in the Fallopian canal. In the small percentage of patients who fail to recover full use of the facial muscles, fibrosis may be assumed to have occurred (5).

The results of treatment in this series tend to support the theory of edema and compression. When no treatment was given, the average recovery time was 19.5 days as compared to 44–55.6 days for patients receiving drugs or physiotherapy. The massage and heat of physiotherapy, in addition to the vasodilator action of some of the vitamins, possibly would increase an edema in the facial canal. Cortisone causes a retention of fluid and sodium while potassium is excreted—a combination of factors that would not be conducive toward recovery of edematous tissue. The glowing reports of recovery due to this drug have not taken into consideration the fact that spontaneous remissions may occur just as rapidly (8-12). This is also true for the claim that stellate blocks produce a more rapid recovery (13).

## Summary

In order to obtain a more accurate clinical and anatomical understanding of the lesion present, the term idiopathic peripheral facial paralysis, with supplemental descriptive phrases, is recommended instead of Bell's palsy. A review of 44 cases has shown that the greatest incidence was in the third decade; no special seasonal variation was noted; the right side was affected more than the left; only 13.6 percent had a definite exposure to drafts, and taste was involved in about 50 per cent of the cases. These facts are in agreement with previously recorded cases (3, 9). In contrast to prior studies, the recurrence rate was only 4.5

per cent in comparison with the 7-13 per cent reported earlier (8, 9). No evidence of infection could be found on physical examination, x-rays, spinal fluid studies, or the usual blood counts. The use of physiotherapy, vitamins, cortisone and BAL was found to prolong the recovery time considerably more than if no treatment was given. Although no treatment produced the most rapid disappearance of the paralysis, it is not the purpose of this paper to advocate therapeutic nihilism in this illness but to point out that treatments, the effect of which could potentiate or aggravate the lesion, should not be employed.

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U. S. Naval Hospital
Oakland 14, California

# BOOK NOTES AND REVIEWS

Books received are acknowledged and given a brief description in this section. Selections serving a variety of interests will be made from these for a more extensive review as far as space will allow.

## BOOK NOTES

*Mowrer, O. Hobard, (Ed.),* PSYCHOTHERAPY: THEORY AND RESEARCH. [New York: The Ronald Press Company, 1953. Pp. 700. 120 illustrations. $10.00.]

Psychotherapy is probably becoming more popular than its actual value justifies when applied in complicated mental disorders. It apparently invites an ever increasing number of adherents and advocates.

This is a large book presented in two parts comprising 19 chapters covering most of the important aspects of psychotherapy. There are 21 contributors with Ph.D. degrees—all well known university professors of psychology or of education. Part I is devoted to theory-concepts and applications and Part II deals with research methods and results.

There is a great deal of interesting material on the historical and philosophical facets of psychotherapy, but the volume's greatest value will be in the nature of the various pertinent research problems formulated and in the attempts made to solve them. The need for additional investigation in this whole field is quite evident from the present status of conclusions and knowledge.

The book directs attention to a great deal of what has been done, published and thought in the past and there are many diagrams and case notes to illustrate the more recent findings and concepts.

The contributors are trained and experienced in psychological research and most of them have probably engaged in some practice of psychotherapy; therefore what they have presented will be of value to students of psychology contemplating a career in this field.

*Fishbein, M., (Ed.),* MEDICAL PROGRESS 1953: A REVIEW OF MEDICAL ADVANCES DURING 1952. [New York: The Blakiston Company, 1953. Pp. 301. $5.00.]

This is a new publication in the form of a year book presenting the recent progress in medicine, surgery and their sub-specialties, for the busy practitioner. There are 17 chapters prepared by 25 outstanding authorities in their particular fields.

In the final chapter the editor evaluates briefly the most important advances. In scope the book is adequate and the style is easily readable. There are useful bibliographies. There is little uniformity in organization of the material or in terminology, and one finds the usual differences in style of presentation characterizing compilations of this type.

The section on psychiatry and psychosomatic medicine is presented by Dr. Francis J. Braceland, who gives adequate highlights of the contributions for the period. If this continues as a yearly publication, a series of the volumes collected will constitute a useful library for the physician in active practice.

*Gedda, Luigi,* GENETICA MEDICA. [Roma: Edizioni dell' Instituto Gregorio Mendel, 1954. Pp. 468. 168 illustrations, 2 in color. L. 5.000.]

This volume presents the addresses and deliberations at the Primum Simpsium Internationale Geneticae Medicae held in Rome in September, 1953. It is a part of the series entitled Anelecta Genetica issued by Professor Gedda.

The text begins with a speech by Pope Pius XII in French in which he explains the attitude of the Roman Catholic Church towards such

scientific matters as evolution, genetics, sterilization, etc., apparently in an attempt to bring the Church and this branch of medical science into some sort of common ground. His address is repeated in English, German and Italian at the end of the book—however, it is theological and not scientific in content.

The book contains over 30 articles, each presented in one of four languages (Italian, German, French and English) with brief summaries in the other three. These articles by the world's outstanding geneticists cover a wide field of medical genetics, including or at least touching upon practically every class of disorders having established hereditary components. Several of the articles are richly illustrated and well repay the reader interested in something other than purely environmental influences. There are adequate bibliographies and an author index as well as a subject index. The paper and printing are excellent. As a whole, it can be highly recommended to all concerned with this field.

*Schneider, Kurt,* PSYCHIATRIE HEUTE (EINE REDE). [2 Auflage, Stuttgart: Georg Thieme Verlag, 1955. Pp. 32. DM 2.85.]

This short book consists of an address by Dr. Kurt Schneider, Dean of the University of Heidelberg, on the occasion of the 565th anniversary of the foundation of the University. According to the author, the problems of psychiatry have not changed very much since ancient history. Sometimes psychiatry did appear to be merely diagnosis and physical treatment of mental illnesses, but today we are moving toward a rather different situation. Psychiatry has expanded to the degree that it deals with all mental processes and therefore it approaches areas of philosophy and metaphysic. In his opinion, psychiatry is based on two main factors: 1) somatology (neuropathology), and 2) phychopathology. In his analysis of psychopathology, he goes into the newer concepts of dynamic understanding that came out of psychoanalytic research. There are still many different opinions concerning the differentiation of psychoses. He speaks of three groups of psychic abnormalities, one being a psychic abnormality in a sense of a modification of a usual emotional make-up, the second which is clearly recognized as resulting from previous organic disturbances, and the third psychic abnormality he named endogenous psychosis. In the latter, he classifies the affective psychoses and the schizophrenic reactions. Here is found either a temporary or permanent disintegration of the emotional processes similar to that only in the recognized organic diseases. The contents of the endogenous psychoses remain, in themselves, completely different from the ones that are seen in psychoses of known organic basis. Schneider reminds us that psychiatry as an empirical science, in dealing with the endogenous psychosis, still should remember to hold on to the postulation of a disease per se. Otherwise it could happen that one might get lost in the multitude of metaphysical speculations. The author ends his speech by saying he cannot give a clear answer to the problems of psychiatry today and claims that his attempt was honest but still only subjective. Quoting Goethe he says: "I can promise to be honest, but I cannot be impartial."

This little book is rather interesting, but for the English-speaking public it will be of value only to people that have a very good knowledge of the German language.

W. T. KOENIG.

## BOOK REVIEWS

*Ey, Henri,* ÉTUDES PSYCHIATRIQUES. III. STRUCTURE DES PSYCHOSES AIGÜES ET DÉSTRUCTURATION DE LA CONSCIENCE. [Paris: Desclée de Brouwer et Cie, 1954. Pp. 787.]

This is the third volume of Ey's attempt to present mental disease from the viewpoint of the theories of Hughlings Jackson on the dissolution of the nervous system. The first two volumes were concerned with history, methodology, general psychopathology and semiology. The present volume treats of the acute psychoses and ends with a philosophical discussion of the disassemblage (déstructuration) of consciousness.

After a brief critique of the classification of mental diseases as it applies to the acute psy-

choses, there follow detailed studies of mania, melancholia, acute deliria and acute hallucinatory psychoses, confusion and confuso-oniric, periodic manic-depressive psychoses and epilepsy. The argument of the book is stated as follows: The group of acute psychoses (attacks of mania, of melancholia, bouts of delirium and hallucinations, oniroid crepuscular states, oniroid confusion—in the form of isolated crises or entering into the group of periodic psychoses or comitial paroxysms) constitutes a continuous series of states which one can only artifically dissociate. They seem to be the natural order of the levels of disassemblage of consciousness, that is to say, of that basal layer of psychic activity which has, itself, a hierarchical structure. The field of consciousness appears, in fact, through the spectral analysis of its pathology, as a resultant of activities which regulate the actualization of experienced living and composes the temporo-spatial organization of immediate experience of "being-in-the-world-there-now." The activity of consciousness and its disassemblage seem to be related to the activity of the "centrencephalon."

Ey promises another volume to complete his Natural History of Insanity. This attempt to make a synthesis of Jacksonian neurology, Freudian psychology and French clinical psychiatry is very interesting and should be important for all students of theoretical psychiatry.

P. B.

*Ombredane, André,* L'EXPLORATION DE LA MENTALITÉ DES NOIRS CONGOLAIS AU MOYEN D'UNE ÉPREUVE PROJECTIVE: LE CONGO T.A.T. [Brussels: Memoir of Inst. Royal Colonial Belge, v. 37, no. 5, 1954. Pp. 244. 18 illustrations. .]

The author, professor of psychology at the Free University of Brussels, studied the psychology o ffive groups of African Negroes in the Belgian Congo. These people live on a very low socio-economic level but both their economic and other cultural conditions are changing greatly because of the mining, industry, and commerce brought in recently by the Europeans. Ombredane had his own set of Thematic Apperception Test pictures made; ten of them are reproduced. He used also three pictures of Murray's T.A.T.: 3 BM, 13 MF, and 14. Ombredane's pictures are quite different from Murray's not only in characters (African Negroes) but also in actions, which represent frequent and emotionally charged scenes from the Congolese's lives. The book summarizes and discusses 400 stories elicted by Ombredane's first eight (all reproduced) and Murray's three pictures. Numerous excerpts from the stories give a good sample of the data collected. One chapter is devoted to the analysis of a 45-year-old man's T.A.T. record and of his wooden sculptures (photographs).

Simple as the T.A.T. technique is, it brings out clearly the difference between Western civilization and that of the Congolese. The author observed a striking "persistent extraneousness of the superego" in the Negroes. Western civilization is characterized by internalization of conflicts with others and of social sanctions associated with marked guilt feelings. The Congolese evaluate their actions in terms of prudence and imprudence and have a complicated system of external magical rituals which can strengthen the efficacy of one's prudent actions, and prevent or weaken the results of imprudent actions. Thus, e.g., adultery is not approved but the parties who have committed it are not faced with disgrace or punishment (internal or external) provided the adulteress' husband is paid the usual price in merchandise. It seems that the social psychosexual norms are quite different in groups which suffer serious and recurrent starvation. Those of the Congolese who have not adapted the norms of Western civilization can be described as "not being responsible for their responsibility." According to Ombredane, they handle severe emotional crises in a more mature way than Westerners do. Nevertheless, the Congolese have their doubts and hesitations. They do not accept all of their own action-tendencies in the same degree; many drives cause serious trouble when acted out. Ombredane observed that those of his action tendencies which were not acceptable to the Congolese were ascribed to T.A.T. figures which differed from the subject in age and sex; the most unacceptable (not necessarily

repressed) drives were frequently ascribed to animals. Ombredane found many "confabulated" T.A.T. interpretations, e.g., a T.A.T. human figure with a prominent set of teeth was interpreted as a crocodile only because the teeth reminded the subject of the animal. The striking differences between the T.A.T. figure and the crocodile were overlooked.

The author strives for a synthesis of concepts employed in a systematic analysis of the T.A.T. stories and offers six rules of interpretation. He is concerned with the problem of the relation between the subject's interpretation of the pictures and his actual social behavior. His two groups of Congolese differ in many respects and these differences are correlated with the differences between the T.A.T. stories of the two groups. The work of several American T.A.T. investigators has been incorporated in a modified form in Ombredane's system. His momoir (which appeared also as a separate book) is a very important contribution to the psychology of personality as well as to anthropology. It presents new facts which were hard to get and discusses many fundamental concepts of the T.A.T. in a lucid and thorough manner. It is of great significance to both practitioners and theorists.

ZYGMUNT A. PIOTROWSKI.

*Rowbotham, G. F., and Hammersley, D. P.,* PICTORIAL INTRODUCTION TO NEUROLOGICAL SURVEY. [Edinburg and London: E. & S. Livingstone Ltd.; Baltimore, Md.: The Williams & Wilkins Co., 1953. Pp. viii-108. $4.50.]

This volume of collaboration between neurosurgeon and artist is intended for general surgeons and those specialists in other fields of surgery who may have occasion to perform neurosurgical procedures in outlying areas where neurosurgeons are not available. Minute details of proper position and draping of the patient for various procedures are illustrated in accordance with the authors' practice. The second chapter shows various skin incisions for access to the skull and for repairing scalp defects. The chapter on skull surgery shows how to make a bone flap or a decompression in the temporal area. Methods of producing intracranial hypotension are included in the chapter on surgery of the brain. Emphasis is on methods of obtaining hemostasis, with plates of illustrations on opening and closing the dura mater and excising brain tissue. Over half of the book is taken up by the last chapter on surgical treatment of head injuries. Cases of epidural hematoma are given in the text and illustrated profusely. Rowbotham believes surgical decompression is indicated when no epi- or subdural clot is found after head injury if the intracranial pressures are obviously high. Closed fractures are described, with indications for operation. Compound head injuries are shown, with emphasis on gentleness in debridement. Repair of dural sinus tears, cerebrospinal fluid leaks, and treatment of osteomyelitis of the skull are illustrated, along with cranioplasty and excision of meningocerebral scars.

The book fulfills its purpose of presenting proper treatment of head injuries for those not specially trained in neurosurgery. The implication might be deduced that more complicated neurosurgical treatment of other disorders could also be handled by the general surgeon, and this I believe to be unfair to both doctor and patient. There is considerable discussion at present, in view of experience with evacuation of head-injured patients during the last wars, as to whether any but the most critically ill patients should remain outside of a neurosurgical center. Certainly general surgeons should know how to deal with epidural hematomas, and the book does well with this subject. I would like to have seen a small section on ventricular puncture, for this can be a life- or eyesight-saving procedure at times. It is somewhat strange that, although pictures of the patient in position for laminectomy are shown, there is no chapter on the procedure of laminectomy, which may well become important for general and orthopedic surgeons if a recent trend to immediate operations for spine injuries continues.

The text is clear; the illustrations simplified and understandable. The reproductions are well made, and the book as a whole reflects credit on the printers and engravers. The book will help those surgeons in training who must know details of head injuries for their examinations, and will be useful in refreshing general practitioners in their memories of how access to the brain is obtained.

# BOOKS RECEIVED FOR REVIEW

ARNOLD, O. H. *Schizophrener Prozess und Schizophrene Symptomgesetze.* Verlag fur Medizinische Wissenschaften, Vienna, Austria.

BAKER, D. M. *Cardiac Symptoms in the Neuroses.* H. K. Lewis & Co., Ltd., London, England.

DEVEREUX, G. *A Study of Abortion in Primitive Societies.* The Julian Press, Inc., New York, N. Y.

FISHBEIN, M. (Ed.) *1955 Medical Progress (A Review of Medical Advances During 1954).* McGraw-Hill Book Co., Inc., New York, N. Y.

*Report of the Third German Congress for Sex Investigation, Vols. I and II.* Ferdinand Enke Verlag, Stuttgart, Germany.

HALL, V. E. (Ed.). *Annual Reviews of Physiology, Vol. 17.* Annual Reviews, Inc., Stanford, Calif.

HESS, W. R. *Das Zwischenbirn: Syndrome Lokalistationen Funktionen.* Benno Schwabe & Co., Verlag, Basel, Switzerland.

HOULISTON, M. *Practice of Mental Nursing.* The Williams & Wilkins Company, Baltimore, Md.

JOHNSON, D. M. *The Psychology of Thought and Judgment.* Harper and Bros., New York, N. Y.

KRABBE, K. H. *Opscula Neurologica.* Universitetsbiblioteket, Lund, Sweden.

LIEBMAN, S. *Stress Situations.* J. B. Lippincott Co., Philadelphia, Penna.

PIERRE DE BIE, LEVI-STRAUSS, C., NUTTIN, J., AND JACOBSON, E. *The University Teaching of Social Sciences: Sociology, Social Psychology and Anthropology.* Columbia University Press, New York, N. Y.

STOURZH-ANDERLE, H. *Die Sexuelle Konstitution: Psychopathie, Kriminalitat, Genie.* Verlag fur Medizinische Wissenschaften, Vienna, Austria.

WALLIN, J. E. W. *Education of Mentally Handicapped Children.* Harper and Bros., New York, N. Y.

WALSHE, F. M. R. *Diseases of the Nervous System, 7th ed.* The Williams & Wilkins Co., Baltimore, Md.

# OBITUARY

## GEORGE H. PARKER, Sc.D. (1864-1955)

Dr. George H. Parker, Emeritus professor of Zoology at Harvard University, died on March 27 at the advanced age of 90 years. He was born in Philadelphia and graduated from Harvard in 1887. For many years he was director of the Harvard Zoological Laboratories and was an associate of the Marine Biological Laboratories at Woods Hole where he spent his summers in research.

Professor Parker was one of the great pioneer experimental zoologists whose early researches enriched the knowledge of comparative neurology of many kinds of mammals, reptiles and fish. His book entitled *The Nervous System*, published in 1919, is a classic in this type of investigation. He wrote several other important books on special aspects of nervous phenomena, and was actively interested in the relationship of biology to human social problems.

He was given several national prizes for his work and he was a member of many scientific organizations, including the American Academy of Arts and Sciences and the American Philosophical Society. His name first appeared on the list of Collaborating Editors of the Journal of Nervous and Mental Disease in July 1918, where it has remained to the present. He was a remarkable investigator, a fine gentleman and an outstanding asset to any scientific group.

## ISRAEL STRAUSS, M.D. (1874-1955)

Dr. Israel Strauss, prominent New York neuropsychiatrist, died in April at the age of 81, after a full life of outstanding professional activity in his chosen field. He was born in Pawtucket, Rhode Island, received his premedical education at Brown University and graduated in medicine at Columbia University.

Dr. Strauss taught histology for a number of years early in his career, and, as pathologist at Beth Israel Hospital, he organized its first department in that specialty. Later he became attending neurologist at a number of hospitals, including the Jewish Hospital in Brooklyn, the Montefiore Hospital in New York and at Mount Sinai.

In 1917 he founded the Jewish Mental Health Society, which ten years later opened the Hillside Hospital in Hastings-on-Hudson for the treatment of acute mental disorders. He was president of this institution from its beginning and was actively involved in its affairs through the many busy years.

Dr. Strauss was a member of many national medical and other scientific societies and served as president of several of these. He was the author of numerous papers dealing with a variety of diseases of the nervous system. His unexpected death was a shock to his personal and professional friends and acquaintances and he will be sadly missed from the midst of our professional ranks.

# NOTES AND NEWS

## THE FIRST INTERNATIONAL CONGRESS OF HUMAN GENETICS, COPENHAGEN, AUGUST 1–6, 1956

An international group of scientists within the field of Human and Medical Genetics has recommended that an International Congress of Human Genetics should be arranged in Copenhagen in 1956. Further they proposed an International Committee for the First International Congress of Human Genetics to be appointed and a permanent International Organization for Human Genetics to be established.

The first proposal concerning the Congress in Copenhagen was made by F. J. Kallmann, New York, M. Lamy, Paris, and C. H. Alström, Stockholm, and this idea has later been supported by numerous human geneticists in many countries.

The Danish Organizing Committee has proposed the following provisional programme: All persons interested in the subject of Human Genetics and especially of Medical Genetics are entitled to be members of the Congress.

The Congress will include: plennary sessions, general and special scientific sessions, roundtable conferences, symposia (eventually), exhibitions, demonstrations, meetings of special committees.

The following is a provisional list concerning the subjects and the sections of the Congress:

Methods in Medical Genetics.
Demography and Medical Statistics.
Genetics and Psychiatry, Psycsology and Criminology.
Genetics and Mental Deficiency.
Genetics and Neurology.
Genetics and Internal Medicine.
Genetics and Surgery and Orthopaedics.
Genetics and Paediatrics.
Genetics and Cancer.
Genetics and Ophthalmology.
Genetics and Otolaryngology.
Genetics and Defects of Speech.
Genetics and Odontology.
Genetics and Intersexuality in Man.
Genetic Carriers in Man.
Human Biochemical Genetics.
Phenocopies in Man.
Genetic Hygiene and Genetic Counselling.
Genetics and Social Medicine.
Genetics of a Human Population including Mutation, Selection, Intermarriage, Isolates, Assortative Mating, Genetic Drift, etc.
Differential Fertility.
Anthropological Genetics including Problems of Parentage and Identification.
Somatology and Constitutional Types.
Twin Investigations.
Blood Groups and Immunogenetics in Man.
Crossing-over and Linkage in Man.
Quantitative and Multifactor Inheritance in Man.
Lethal Genes and Sex-linked Genes in Man.
Cytological and Radiation Genetics in Man.
Genetics and Experimental Pathology.

A definite list of the sections will be given in the final programme according to the subjects of the communications received.

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## CONFERENCE ON JUVENILE DELINQUENCY

Real hope for the solution of the country's juvenile delinquency problem lies in a scientific attack on all phases of child conflict and maladjustment. This was one of the conclusions reached in a conference on exploring psychiatric research in juvenile delinquency sponsored by the Welfare and Health Council of New York City, on March 4–5, at Princeton, N. J. Participating were 25 psychiatric and other professional leaders.

The conference agreed that research can be most productive if it operates within the following principles:

1) That major focus be placed on young children.
2) That studies of the adolescent period go forward simultaneously.
3) That studies which would develop information on growth and maturation be undertaken.
4) That attention be given to the problems of identification and early education of delinquency characteristics and danger points.
5) That precise research methods and yardsticks be developed.

Five main areas of research were charted:

1) A study of personality traits to determine the elements which predominate in individuals and groups found to be delinquent.
2) An examination of group activity in order to understand the negative behavior characterized as delinquent.

3) Investigation of societal conditions and movements which affect personality. In this connection, it was pointed out that the pschiatrist must get into the community and not depend solely on the clinic and hospital for his data.

4) Anthropologists and other scientists should team up with psychiatrists to obtain a broad appreciation of the effect of culture and sub-culture rivalry in creating disorder and frustration among the nation's youth.

5) Studies should be undertaken which will yield a better understanding of the interaction between the individual personality and his environment.

Among the locales suggested for effective investigation were the following:

1) The home and family—especially for observation of the early years and the stages of maturation.

2) The clinic and hospital—for children and youths referred because of special problems.

3) The school, the playground and the residential center—for study and analysis of group behavior.

4) The neighborhood and larger community—for observation of youngsters at free play, work, and in the process of forming associations.

5) The social agencies—where social and family services are provided.

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## UNIVERSITY OF CALIFORNIA EXTENSION COURSE IN NEUROLOGY

Included in a group of single session classes in Recent Advances in Medicine which University of California Extension will offer at the Medical Center on the Los Angeles campus this summer will be a July 27 afternoon session on Problems in Neurology.

The focus for attention in the program will be those disorders of the nervous system which occur with great frequency. In addition, the role of the electroencephalogram in the diagnosis of convulsive disorders and brain lesions will be described.

Information concerning this and other U.C.L.A. summer medical courses is available on request to Thomas H. Sternberg, M.D., Assistant Dean for Postgraduate Medical Education, University of California, Los Angeles 24.